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AMERICAN RAILWAY JOURNAL.

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During the year 1891 there were incorporated in the United States, according to the records of the United States Corporation Bureau, of Chicago, a total of 15,294 corporations, with an aggregate authorized capitalization of nearly $6,000,000,000. The different classes of corporations are grouped as follows:

	No.	Authorized capital stock.
Mercantile and manufacturing cos...	6,656	$1,073,244,144
Gold, silver and other mining and smelting cos	1,219	1,634,092,900
Coal and iron cos	358	153,471,830
Banks and investment cos	768	257,164,800
Light, heat, power and transportation cos	1,015	681,649,350
Building and loan associations	572	1,709,183,610
Miscellaneous cos	4,706	241,576,128
Totals	15,294	$5,730,892,792

These figures tend to show how rapidly corporate forms of conducting business are growing in favor, but the actual amount of new capital invested in these companies is probably but a small percentage of the grand total given; for, as everybody knows, the figures include many companies having millions or hundred thousands of capital authorized, but with only hundreds paid in. Moreover there have been very many instances of the reorganization of old companies under new charters, and of partnerships, and even the business of individuals, merged into corporations; all with little or no addition to capital employed in business. It is surprising to note how small a proportion of the vast total is made up by the capitalization of new railway corporations.

Levee contracts, to the amount of $1,814,579, were let last year by Mr. Wm. Starling, Chief Engineer of the Board of Mississippi Levee Commissioners. Mr Starling visited Holland last year in the interest of the Board and carefully examined the river-dyke system of that country. His report will be submitted to the American Society of Civil Engineers in the form of a paper. He says, in his official report, in discussing the cause of floods, that as far as the Mississippi River is concerned there appears to be no evidence to favor the common theory that deforesting is an important agent in producing the recent floods. As proof he shows that the flood on the Ohio River of 1847 was never surpassed until 1883-84, and the greatest flood in the Mississippi was in 1847 and has never since been approached by 4 ft., and the nearest approach was in 1858. In the Lower Mississippi the great flood of 1828 was never exceeded until 1882, and there the excess was doubtful. Mr. Starling ascribes the later heavy floods merely to an excessive rainfall from storm centers originating in the Gulf of Mexico and passing northward.

A trolley decision, by the New York Railroad Commission, and relating to the Coney Island and Brooklyn companies, grants permission for a change of motive power under the following conditions: The change may be made from horses to the overhead single trolley electric system, provided: (1) That the company shall put a guard wire over the trolley wire to prevent contact with broken telegraph and telephone wires. (2) No car shall be run with less than two men to operate it, and every car is to be equipped with guards in front of the wheels, coming within 2 ins. of the track.

The Chicago Drainage Commission, through its new engineering committee, favors a reconsideration of the Chicago end of the line, and also that part of the route between Sag and Lockport. No new route is yet recommended, but from the reports of the meetings of the present board, in the Chicago papers, it is evident that there is considerable work ahead for engineers in revising plans and making estimates.

Three-thousand mile railway tickets are issued by the Northern Pacific Ry. Co. They sell for $75 and are good on all the lines of the system. Heretofore 1,000-mile tickets have been the largest we have any knowledge of.

Irrigation by means of the ordinary rotary lawn sprinkler, on a larger scale, is proposed by Mr. Harry Mullison, a ranchman living near Saratoga, Wyo. Mr. Mullison's plan includes stand-pipes 32 ft. high with revolving iron sprinklers having 9-ft. arms, each sprinkler to irrigate an acre. It is reported that the agricultural department of the Wyoming State University has made an appropriation sufficiently large to enable Mr. Mullison to erect ten of his sprinklers on the State Experimental Farm at Saratoga, Wyo.

The University of Missouri, which was burned on the night of Jan. 9, as previously announced, lost in the destruction of the main building its entire library, all the physical laboratory apparatus, the geological cabinet and biological museum, and the entire plant of the testing laboratory. The total loss was $400,000, with an insurance of $140,000. The testing laboratory was fully insured and will be speedily replaced. Prof. Hiram Phillips, of the civil engineering department, writes that it is authoritatively announced that Gov. Francis will call a special meeting of the legislature to consider the rebuilding of the university.

The most serious railway accident of the week was a derailment Jan. 15 on the Northern Pacific R. R. near Brainerd, Minn., and was apparently of a similar character to the accident on the Louisville, New Albany & Chicago R. R. noted last week. A broken rail is given as the cause. The train was a special and the engine and baggage car remained on the track, but the sleeping car went down a 5-ft. embankment, falling on its side. The car caught fire almost immediately from the overturned stove and was entirely consumed, but nearly all the passengers escaped through the windows. There were two persons killed and burned in the wreck and 23 persons more or less injured.

The danger of grade crossings in cities has again been shown by a serious crossing collision at 47th St. and Stewart Ave., Chicago, Ill., on Jan. 14. The Pennsylvania limited ran into a crowded street car, smashing it and throwing it from the track. There were two persons killed and 15 injured, mainly by cuts and bruises. It is said that the gateman allowed the car to get on the track and then let down the gate in front of it.

Another collision on the New York Central on Jan. 20 at Yonkers, just out of New York City, seems to have been due to the absence of a block system. It occurred between the Montreal express and a freight train which was obstructing the main track "getting out of the way." Two freight cars were destroyed, blocking the road for some time. The alleged cause was the failure to act of one of the "hand operated station semaphores" on account of freezing. We need hardly say that in such block signal plants as the Central is about to erect, or in such as has been in use for nearly ten years on the Providence & Worcester road, no such failure of a signal to show danger when danger exists is structurally possible.

The bridge which the Union Bridge Co. was building on the line of the H., C. A. & N. R. R. across the Red River at Alexandria, La., was struck by a tornado on Dec. 3. The traveler had been erected for the drawspan, 360 ft. long, and the actual erection of the span had been begun, the four tower posts, 50 ft. in length, had been hoisted into position, but fortunately had not been connected to the bottom chord. The traveler was literally smashed to pieces and the four posts were carried over the side of the pier and dropped into the river a distance of about 50 ft. Two posts were completely wrecked; the other two were slightly injured and it was first intended to repair them. It was finally decided to make four entirely new posts. Through a miscarriage in the forwarding of some telegrams the order for the first pair did not reach the shops (at Athens, Pa.) until the 7th. On the 10th the other pair was ordered. The material was ordered from the mills and the work pushed so that the four posts were shipped out of the shops on the 14th, or four days after the second pair was ordered. The posts reached Alexandria on the forenoon of the 23d, and were placed in the bridge on the 24th and 25th and the span was turned on the 29th. The first train crossed on the 31st, and regular traffic over the bridge began on Jan. 1. Between the date of the accident and that of the arrival of the new posts a new traveler had been built, the span erected and connected up ready to receive the posts, the machinery put in and the work generally put in such shape as to cause no delay between the time of setting in the posts and of turning the draw.

Inside cylinder locomotives are practically obsolete in this country and it is interesting to note that two such engines are now in service on the Fitchburg R. R., one being used for switching and the other on the Western Division (Troy & Boston). They were both built by the Hinkley Locomotive Works, and have cylinders 16 × 20 ins.

The English shipbuilding record for 1891 shows 19 warships launched, aggregating 108,000 tons and costing complete $29,272,935. This list includes three battle ships of 14,150 tons each, of 17½ knots speed, and three first class cruisers of 7,500 tons each, of 20 knots speed. The first named vessels are armed each with four 67-ton guns, and cost $4,250,000 apiece, and the last with two 22-ton guns and cost $1,850,000 each.

The Chignecto Ship Railway Co. has applied to the Dominion Government for aid in completing its work. The first proposition is that the government purchase $1,500,000 of the company's bonds. The second is that payment should be commenced, on July 1, of the Federal subsidy which amounts to $170,000 for 20 years. This subsidy was granted under the express condition that it was not to be paid until the road was in running order. So far, the government has refused to accede to either proposition.

The bursting of water pipes by frost, it is claimed, can be prevented by a device invented by H. E. Burnet, of London. He inserts within the pipe suitable lengths of a sufficiently, elastic material, such as cork, protected by a thin covering of metal or canvas. This material may be round, flat or semi-circular in section, and it is to be kept in place by light projecting arms. The so-called "preventer" is supposed to be compressed under the pressure of the expanding, frozen fluid and thus to relieve the pipes. The inventor says that the "preventer" is of such dimensions as "not to materially diminish the water supply."

An 8½-ft. steel intake extension for the Cleveland water-works, noted in our issue of Nov. 10 as proposed by Mr. R. Powell, of Cleveland, now seems to stand a fair chance of being adopted. The plan is to extend the intake from the present lake crib 2½ miles further into the lake by means of a large pipe laid on the lake bottom, the pipe to be floated to place and sunk to position. This plan is proposed as a substitute for a masonry lined tunnel, which, we understand, present plans include. According to press dispatches, Mr. Powell has organized a company, and has proposed to put down the pipe and wait ten years for his pay, charging a low rate of interest. It is stated that the plan has been indorsed by Mr. W. F. Goodhue, Consulting Engineer of Milwaukee; J. C. Des Granges, the engineer in charge of the new four mile water-works intake tunnel at Chicago; William H. Searles, of Chicago; E. W. Naylor, J. A. Bidwell, A. E. Brown and W. P. Rice, well known Cleveland engineers, the latter once the City Engineer. One of the objections urged against the intake has been the danger from vessel anchors. Engineer Goodhue replies to this that the pipe would be too large to catch an anchor and that in addition drifting sand and debris would in a few years cover and protect it. At latest report the plan was still under consideration. In Engineering News for Oct. 25, 1890, there was described and illustrated a new intake under construction at Milwaukee, Wis., somewhat similar in design, although the pipe will be smaller. At Milwaukee a tunnel is being driven about 3,000 ft., and from a crib at the end of the tunnel two 5-ft. cast-iron pipes will be laid in a trench in the lake bottom, 8 ft. deep and 18 ft. wide.

The New York Transit Co., with a capital of $5,000,000, was incorporated at Albany, N. Y., on Jan. 13. This company is to own and operate for public use the oil pipe line extending from Olean to New York Bay, a distance of 377 miles, and a line now running from Olean to Buffalo. It is also to construct and operate another line laid parallel to the above and such branch lines as are found necessary. The directors are H. M. Flagler, Wm. Rockefeller, D. O'Day and other prominent Standard Oil owners.

A metric standard, established in terms of wave lengths of light is the object of the mission to Paris of Prof. A. A. Michelson, of Clark University, Mass. By invitation he will spend the coming summer in the laboratory of the International Bureau of Weights and Measures, at Bretenil, near Paris. He is asked to make the basis of the unit of weight natural instead of arbitrary, and to apply his method of wave lengths of light to the testing of standards established by less precise methods. The apparatus needed is now being made at Waltham, Mass.

The Baldwin Locomotive Works, of Philadelphia, Pa., built 918 locomotives during 1891, of which 161 were four-cylinder compound engines. The total was 35 less than the number built in 1890, and comprised 9 decapod engines (10 driving wheels), 219 consolidation (8 driving wheels), 423 with six driving wheels, 266 passenger and switching engines with four driving wheels, and one rack engine,

MACHINERY OF THE U. S. S. "NEW YORK."

In many respects one of the most important vessels of the new navy is the "New York," in which the combination of sustained speed, great coal endurance, a powerful battery and a certain amount of armor protection tend toward making her a cruiser of no ordinary character. A great deal has been said from time to time about this vessel, her battery arrangements, and so forth; but little space comparatively has been bestowed upon her machinery, which, when it was designed, was considered the greatest achievement in the really remarkably successful administration of the affairs of the naval bureau of steam engineering by its present head, Engineer-in-Chief Geo. W. Melville.

The hull and machinery, including engines, boilers and appurtenances, complete in every respect, in accordance with the plans and specifications provided by the Navy Department and modified by the bidder, were contracted for by Messrs. William Cramp & Sons, of Philadelphia, for $2,985,000. The modifications embrace a rearrangement of the boilers, so that additional longitudinal and transverse bulk-heads could be fitted in the engine and boiler spaces, thereby affording greater protection to the machinery, and rendering the vessel less vulnerable to attacks from rams and torpedoes.

In the "New York" the speed given, 20 knots, is sufficient to enable her to escape from any more powerful ship afloat to-day, and to overtake the vast majority—say 95%—of all the ships of the world, naval or mercantile. At the same time her size and draft are not excessive. Her coal capacity of 1,500 tons permits her to complete without recoaling a voyage of 13,000 miles, at a speed of 10 knots an hour, the arrangements of the engines showing great economy at low speeds. She is both a commerce protector and a commerce destroyer of the highest efficiency, and, for general purposes of service, is believed to have a wider field of usefulness than any other ship yet designed.

The engines, of which there will be four sets, two of which will be rights and two lefts, placed in two water-tight compartments, were recently set up in the shop, at which time the accompanying picture was taken. They are now being dismantled for the purpose of installing them in the vessel. Two of the engines are on each shaft. The crank shafts are so arranged that by means of an easily operated coupling, the forward set may be quickly and easily connected with or disconnected from the after one at will. For ordinary cruising the after set attached to each shaft will be used.

These engines are of the vertical inverted cylinder, direct acting, triple expansion type, each with a high pressure cylinder, 32 ins., an intermediate pressure cylinder, 46 ins., and a low pressure cylinder 72 ins. in diameter—the stroke of all pistons being 42 ins. It is estimated that the collective indicated horse power of propelling, air pump and circulating pump engines should be 16,000, when the main engines are making 129 revolutions per minute. The high pressure cylinder of each engine will be forward and the low pressure cylinder aft.

The main valves are to be of the piston type, worked by Stephenson link-motions with double bar links. There will be one piston valve for each high pressure cylinder, two for each intermediate pressure, and two for each low pressure cylinder. Each main piston will have one piston rod, with a cross-head of forged steel working between guides. The framing of the engines consist of cast gun-iron inverted Y frames, two for each cylinder. The engine bed plates are of cast steel, supported on wrought steel keelson plates built in the vessel. The crank shafts are in three sections. All shafting will be hollow. The shafts, piston rods, connecting rods, and working parts generally are forged open hearth steel.

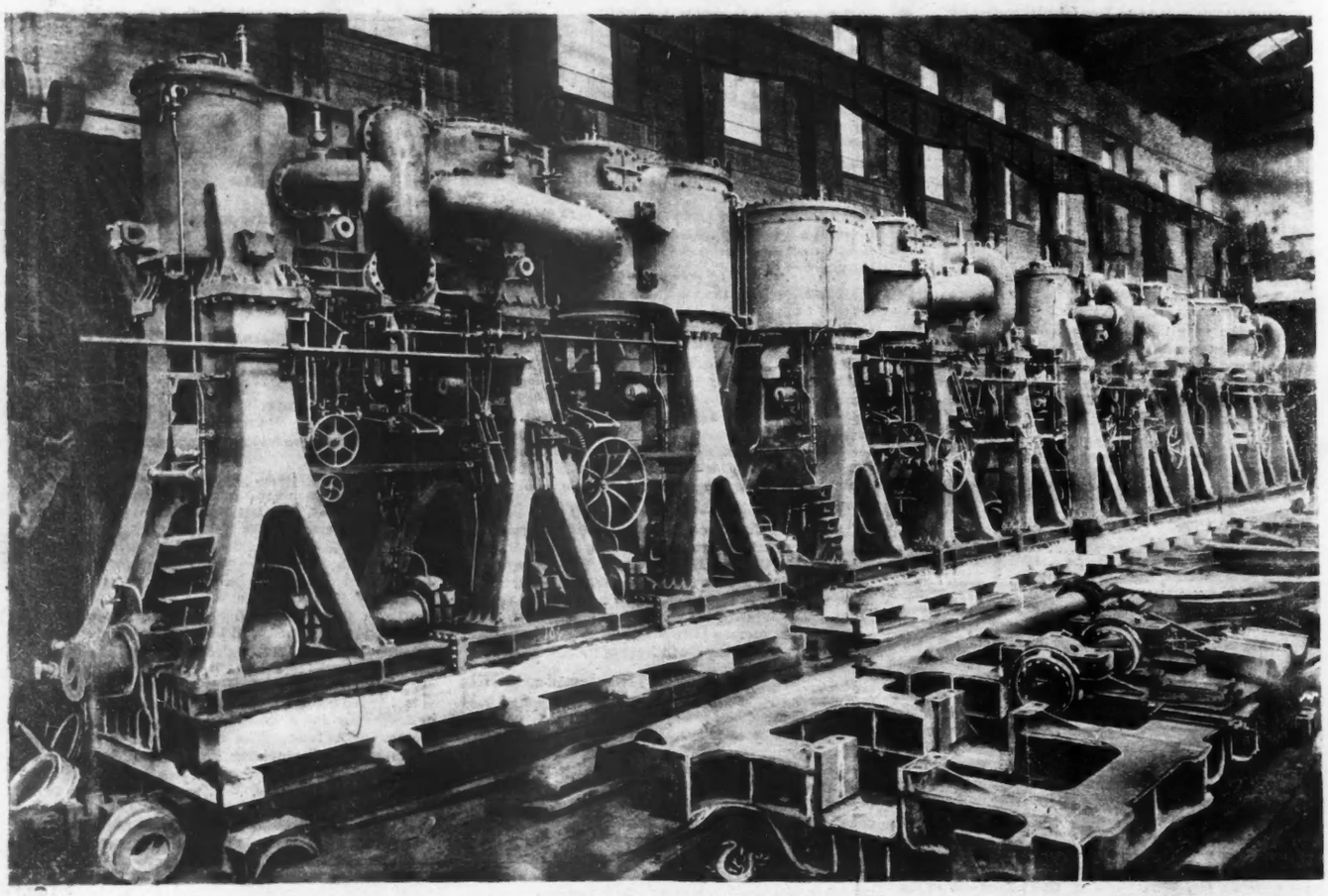
The condensers are of composition and sheet brass, one for each propelling engine. There are also two air pumps of the Blake pattern for each propelling engine. The main circulating pumps are of the centrifugal type, one for each condenser, worked independently. The throttle valves are a combination of the piston and the butterfly valves. The Cramp steam reversing gear has been adopted in place of what was originally designed. There are auxiliary condensers to be fitted in each engine room and they will be of the Wheeler type, of sufficient capacity for one-half the auxiliary machinery. The propellers are rights and lefts of manganese bronze.

There are six double-ended boilers made of steel placed below the protective deck, and two auxiliary boilers placed above it. The former are 15 ft. 9 ins. in diameter and 18 ft. long, arranged in groups of two abreast, with three smokestacks. Each boiler is to have eight corrugated furnace flues, 3 ft. 3 ins. internal diameter. Their total heating surface will be about 31,190 sq. ft. and the grate surface 988 sq. ft. The auxiliary boilers have two corrugated furnaces, each with 64 sq. ft. of grate, and 1,937 sq. ft. of heating surface.

The boilers are now undergoing their hydraulic tests to see whether they are sufficiently tight and can stand the pressure. They are completely filled with water and fires of light wood and shavings are started in their furnaces, thus slightly heating and expanding the water and bringing on the pressure they are required to stand, which is 250 lbs. per square inch. The working steam pressure will be 160 lbs. per square inch. The somewhat severe tests are being stood remarkably well, and the workmanship has been pronounced by the naval experts present as being of a high order and extremely satisfactory.

The forced draft system consists of three blowers for each fireroom for the main boilers, and one in each fireroom for the auxiliary boilers, the blowers for the main boilers discharging into an airtight fire room. Airtight bulkheads will be used so as to reduce the space to be maintained under pressure.

She will be a mass of machinery, for in addition to the main engines there are to be steam-reversing gear, ash hoists, turning engines, auxiliary pumps, engine-room ventilating fans, engine for workshop



THE ENGINES OF THE U. S. CRUISER "NEW YORK." William Cramp & Sons, Builders.

machinery, hydraulic pumping plant for various purposes, gun-table for turret-turning engine, distilling apparatus, anchor engines, a number of dynamos, and a vast number of other auxiliary and supplementary machinery.

Chief Engineer John Lowe, of Arctic fame, has received a well-deserved recognition of his merits and fine record during the thirty-one years he has been in the Navy, in having been ordered to superintend the construction of this machinery. Later he is to go out in the ship as her chief engineer.

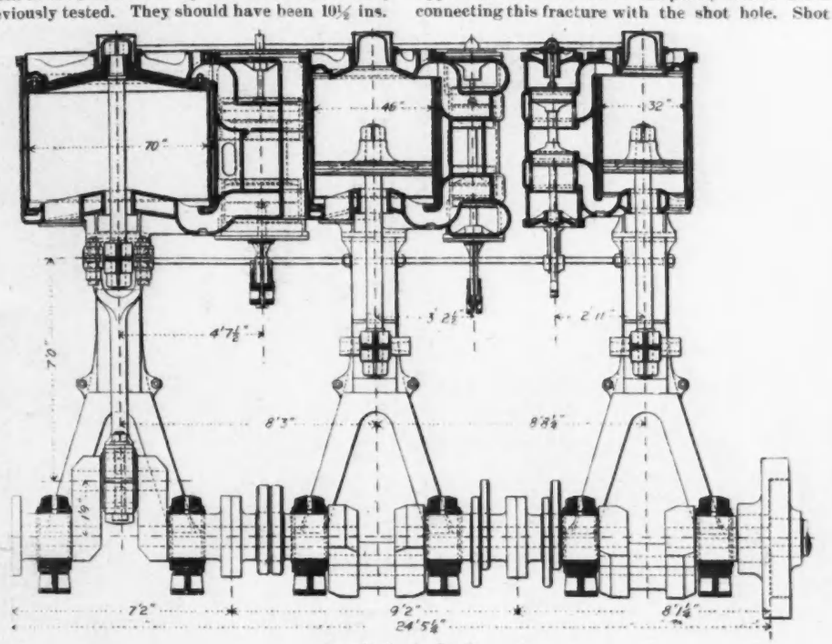
NICKEL-STEEL ARMOR TESTS.

High carbon nickel steel armor plate was again victorious, as compared with low-carbon all steel plate, in a trial at Indian Head on Jan. 12. Both plates were submitted to the Harvey process of surface carbonization by their makers, Carnegie, Phipps & Co., and were similar in chemical composition to the plates made by the Bethlehem Works, previously tested. They should have been 10½ ins. thick and 8 by 6 ft. But some defects in the plates reduced these dimensions somewhat and lessened their value in that degree for comparative purposes. The all-steel plate was warped and was planed down to about 9⅛ ins. thickness at the sides, and the nickel steel plate was cracked and 20 ins. were cut off, making it almost square. Three 6-in. shots were fired so as to form an isoceles triangle on each plate, with its apex 2 ft. below the upper edge of the plate and the base 2 ft. from the bottom and the sides. The fourth shot was made with an 8-in. gun in the center of the triangle.

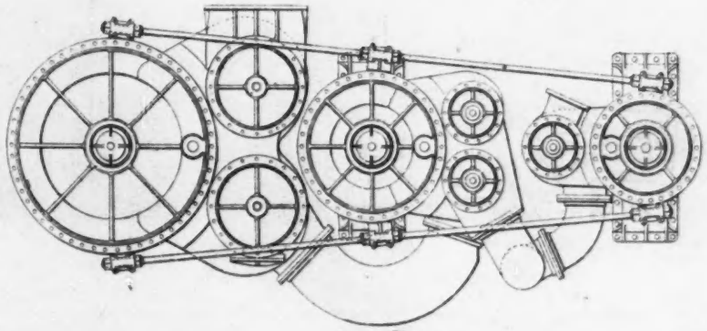
All the conditions of the trial were as before. For the 6-in. shots a forty-caliber gun was used. The Holtzer projectiles were weighted to 100 lbs. each. The powder charge was 42.4 lbs., giving a striking velocity of 2,075 ft. and a striking energy of 2,989 ft. tons. The 8-in. projectiles were made by Carpenter, and weighed 250 lbs. each. They were fired from a thirty-five caliber gun with a charge of 72½ lbs. of powder. The striking velocity was 1,700 ft. per second and the striking energy 5,008 ft. tons. The 6-in. projectiles were fired first. The first shot was at the upper right hand corner of the all-steel plate, which was completely perforated with a total penetration of 39⅛ ins. The plate was not cracked. The next shot was at the apex of the triangle in the nickel steel plate. The projectile penetrated 11⅛ ins. and rebounded slightly broken, leaving an irregular hole from which chips of metal flew over the bombproof and far out into the Potomac River. No cracks were visible.

Shot No. 3 was at the upper right hand corner of the all steel plate. It penetrated 30 ins. in the plate and backing, and cracked a triangular piece off the upper right hand corner of the plate, with a crack connecting this fracture with the shot hole. Shot No. 4 was fired at the lower right hand angle of the triangle on the nickel steel plate. It penetrated 13 ins. leaving another ragged hole from which there was another shower of chips. There was still no crack in this plate. The fifth shot struck the lower left hand corner of the all steel plate, and penetrated 35 ins. in the plate and backing. The previous cracks were widened and a new crack developed between the two upper shotholes.

Shot No. 6 was at the lower left hand angle of the triangle on the all-steel plate. It penetrated 11 ins. and remained intact in the shothole. A slight crack extended to the side of the plate. The seventh shot was at the lower right hand corner of the all-steel plate. It penetrated the plate and backing 43 ins., and a new crack was opened up from the upper left hand hole to the left edge. This was the last shot with the 6 in. gun, which was then dismounted and replaced by the 8-in. weapon. The first shot from this gun was at the center of the all-steel plate. It went clear through the plate and backing, struck the sandbank behind them, and glanced over. It was picked up uninjured. The last shot was at the center of the nickel-steel plate, which had been so weakened by the three shots already grouped so close together that it was wrecked. The projectile encountered so little resistance that it went on into the sand mound. Cracks from two to three inches wide extended from the center through each shothole to the edges The test again demonstrated the advantages of nickel-steel, especially in connection with the Harvey process. The nickel plate, owing to its small size and the close grouping of the shots, was subjected to a very severe strain, yet until it had been weakened by three shots it kept all the projectiles out. The all-steel plate let every projectile through. Owing to the defects in these plates, they cannot be accurately classed with the others tried. There is no question that the all-steel was the poorest of the eight fired at in the series of tests, while the nickel-steel, had it been full size, would probably have ranked about third, or possibly second.



Longitudinal Section.



Plan.

THE ENGINES OF THE U. S. CRUISER "NEW YORK," William Cramp & Sons, Builders.

WORLD'S COLUMBIAN EXPOSITION.

Water Supply.

The note on the water supply of the exposition in our issue of Jan. 16 needs some further explanation. The main supply for the exposition, machinery, fountains, etc., will be pumped direct from the lagoon by a special plant located within the grounds and consisting solely of Worthington engines with a total capacity of 40,000,000 gallons per day. This pumping plant is intended to be a model of American practice in its construction and equipment. It will be built by the exposition management, but will be under the direction of the firm of Henry R. Worthington. This plant is practically the fire protection of the exposition, as it is so arranged that in case of fire the pressure may be at once increased from the low service required for mechanical use and fountains to a pressure far above that of the city supply and sufficient to cover the highest buildings. The equipment will include appliances for the largest series of luminous fountains yet constructed. The front of the main engine-house will be decorated, with ten medallions in bas-relief of prominent hydraulic engineers now deceased.

The entire supply of potable water will be taken from the city mains coming from the lake tunnel and pumping station at Hyde Park. This will hardly exceed 3,000,000 gallons per day, the remainder going to the city. At the Hyde Park pumping station is located machinery by several prominent makers, forcing the water to the city through a 36-in. main, from which a pipe will be run to connect with the pipe system of the exposition.

The present plant at this station has a total capacity of about 30,000,000 gallons per day, but an additional plant of two Gaskill engines, with a daily capacity of 24,000,000 gallons is to be put in, which, we are informed by Mr. McHarg, the Engineer of Water Supply and Sewerage, will be exclusively for the use of the exposition until the close, when it will be acquired by the city, as noted last week.

The durability of iron railway bridges, says the "Zeitschrift für Transportwesen," is being investigated by several of the European Governments as a consequence of the late serious bridge disasters. The result of extended English and German investigation seems to show that under the most favorable circumstances iron bridges are not safe for a period exceeding 75 years; and under certain conditions their life is much shorter. The method of manufacture is of the least importance in this estimate of durability. The effect of a more or less heavy traffic upon the fibre resistance in the materials of construction plays the important part, and the pounding under train motion and the vibration due to rolling loads wear out the bridge.

The High St. viaduct plan in Columbus, O., was approved by the Board of Public Works on Jan. 15, and referred to the City Council for immediate action. The estimated cost is $608,905, with $118,000 to be deducted from this amount for street property and benefits. Including approaches the viaduct will be about 1,400 ft. long, with a plate-girder bridge 240 ft. long and 4 ft. deep over the railway tracks.

UTILIZATION OF THE FALLS OF NIAGARA.

By Clemens Herschel, M. Am. Soc. C. E., Consulting Engineer, Cataract Construction Co.

Of the sources of power on the globe we inhabit, which are, (1) the various forms of heat engines driven by the combustion of some sort of fuel, (2) water power, (3) windmills, (4) animal power, and (5) if one chooses to add it, the solar engine of Ericsson and others, all but steam engines and water wheels are only available for small developments of power. As between steam engines and water wheels, water wheels have always furnished, and still furnish, the cheapest mode of producing power at points where water power is available. Were it not for the fact that power is in large demand at points distant from any waterfall, and demanded also in portable form, the steam engine could in no wise compete with water power.

By offering a ready and commercially practicable method of transmitting power, the modern methods of electrical, pneumatic, hydraulic and wire rope transmission of power have enhanced the values of existing water powers very much. Especially is this true in the case of water powers not hitherto utilized, or which could not hitherto be utilized; and it is largely owing to this modern development of methods of power transmission, that a beginning has been made in the utilization of some portion of the mighty power of Niagara Falls.

The difficulties to be overcome in any plan for the utilization of a given water power, are twofold: physical and legal. As regards the first, it is not enough to concentrate the fall, if need be, by dams and canals, and to set up wheels to be acted upon by this fall; but there must also be planned a scheme of streets and mill sites, suitable for the development of a manufacturing district. Mill sites must have a sufficient area upon which to place the buildings requisite for economically employing the power allotted to them; they must be in communication with the railways of the locality in question; and generally must afford modern conveniences for manufacture. Very often the situation is such that all this becomes impracticable, upon which the mill site either loses in value, or becomes totally worthless.

But with an economical transmission of power once established, such situations again become valuable for manufacturing purposes. The power can then be generated at a point most convenient for that specific object; while the mill site can be laid out, and the mill built, several miles, it may be, from the source of power. Several electrical power plants of this sort are already in existence, and recent developments of electrical power transmission at Frankfort and elsewhere give promise of much more work of this sort in the future.

The legal difficulties above referred to are no less serious. So long as the building of water power canals is not considered as of public use, the right of eminent domain cannot be exercised for the taking of the lands necessary for the construction of dams and canals, not to say for the laying out of mill sites. Many of the States of the Union have flowage acts dating from the first settlement of the country, and from a time when the erection of a town grist mill or saw mill was palpably of public utility. They permit the flowing of alien lands for purposes of forming a mill pond; and to that extent confer rights of eminent domain on the mill builder. Some of the water acts of continental Europe give the owner on one side of the river the right to take the opposite shore, under certain restrictions, for the purposes of constructing a water power dam. But generally the construction of such works in older settled districts has been much hampered, and often, nay, generally, rendered impossible, by the absence of a right of eminent domain for the acquisition of the necessary lands.

This is the state of affairs which has hitherto prevented a utilization of Niagara Falls. It has also caused the utilization of waterfalls in Europe, to assume a totally different aspect from that obtaining in this country.

At Schaffhausen and Fribourg, in Switzerland, and at Bellegarde, turbines were set up in groups, at a so-called power house, near the river, the power being then transmitted by wire ropes to the several mills or manufactories; while the American system has always been to carry the water to the several mill

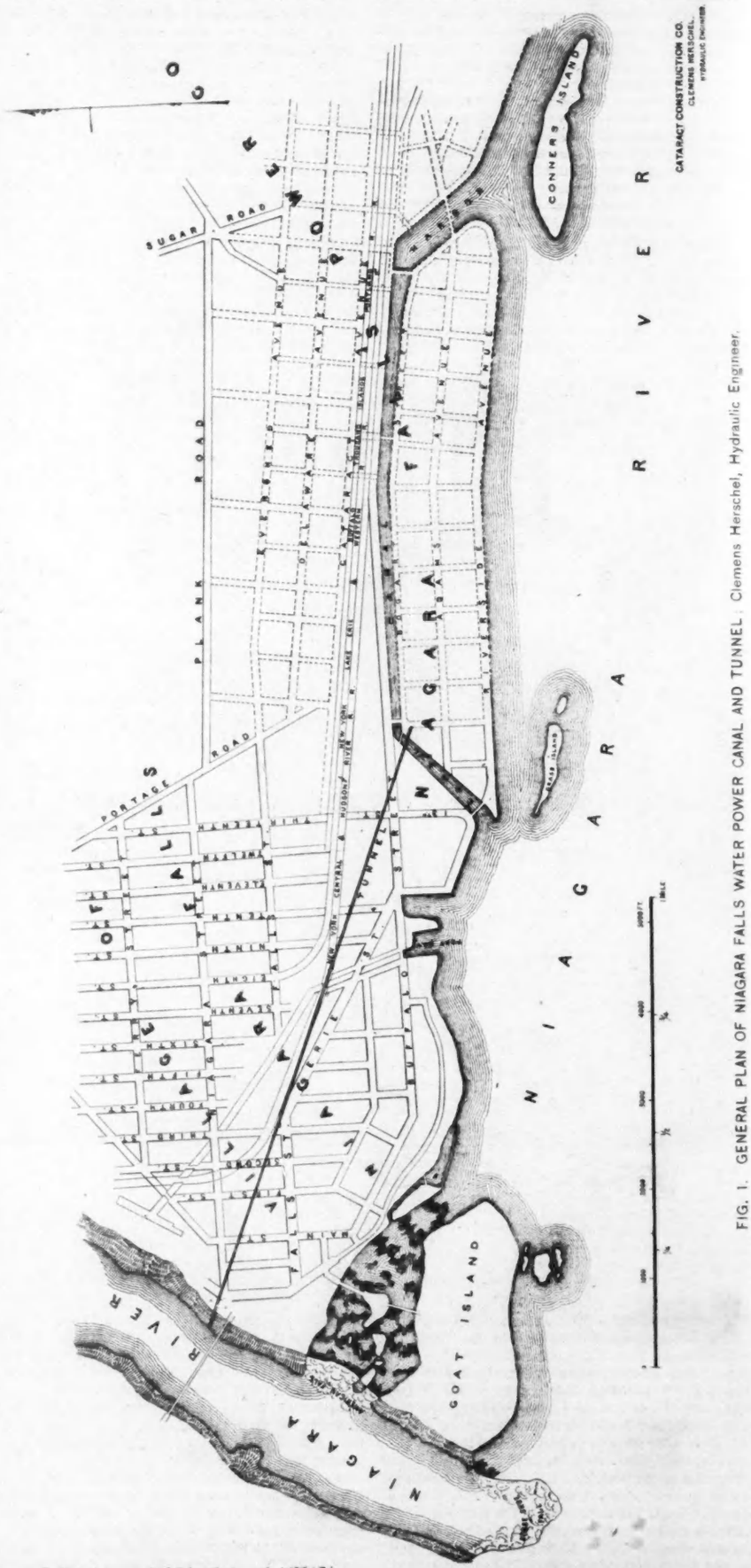


FIG. 1. GENERAL PLAN OF NIAGARA FALLS WATER POWER CANAL AND TUNNEL. Clemens Herschel, Hydraulic Engineer.

sites, each mill site having upon it its own turbines. This American system has been rendered possible either by the opportunity secretly to buy large tracts of unimproved land, surrounding or adjacent to the power to be developed, or else by the conversion of some navigation canal into a water power canal. The history of Lowell, Lawrence, Holyoke, Lewiston and Augusta, in the East, not to mention more recent water power developments elsewhere in the United States, will illustrate the point above referred to.

In the absence of the right to take by eminent domain, or of opportunity to buy the large tracts of unimproved land adjacent to the Niagara gorge, large contiguous tracts of land at reasonable rates. The original plan contemplated also a series of inlet canals, at right angles to the shores of the upper Niagara River, and a series of mill site blocks between them.

After various fruitless efforts to make a commencement on the ground, the present Niagara Falls Power Company was organized in succession to the company above named; also the Cataract Construction Company, which is building the tunnel and other works necessary for the utilization of, primarily, 20,000 HP., with parts of the works of 100,000 HP. capacity. When it is considered that 100,000 HP., available night and day, is equal to about five times the water power of Lowell, Lawrence and Holyoke combined; and that these cities have grown by means of their water power to their present combined population of some 150,000 people in about 45 years; and when it is further considered that freight rates to New York and to Boston are no greater from Niagara Falls than they are from the cities named, while to and from the South and West they are very much less for Niagara Falls than they are for the above New England cities; when all this is properly viewed, a prediction that the future city of Niagara Falls will have a million inhabitants within 50 years does not sound like a rash one. Such a view contemplates, however, only the use of the power generated at Niagara Falls in its immediate vicinity; and only refers to the use of some 150,000 or 200,000 HP.; as representing five or six times the total power, water and steam, which has gone to build up the three named manufacturing cities. Besides this, it is more than likely that Buffalo and other distant points will get power from Niagara Falls; and to reassure those who fear that the supply of power may become exhausted, it is but necessary to state that Niagara Falls, used on 140 ft. fall (the fall available on the works now in construction), represents over 3,000,000 effective and available horse power. The present works are therefore intended, ultimately, to utilize only about 3⅓% of the available power; and a city of a million inhabitants could be built up on utilizing less than 7% of the available power.

So that, from the standpoint of the tourist and the lover of nature, neither the surroundings of the falls nor the falls themselves will lose in beauty by the works contemplated. The mill buildings nearest to the falls will be about 1½ miles above them, and the quantity of water going over the falls will not suffer as much diminution from the normal flow, by the draft for power purposes upon them, as that normal flow now suffers on days when the wind blows upstream for 24 or more consecutive hours.

The accompanying drawings show the plan of works now in progress, from which it is expected to deliver power within the year 1892.

In all works of this character the possibility of a gradual growth of the whole plant, without interference with the portions already in use, is a point of prime importance. It is believed that this feature of the general plan has been carefully provided for. The part now building is the down stream end

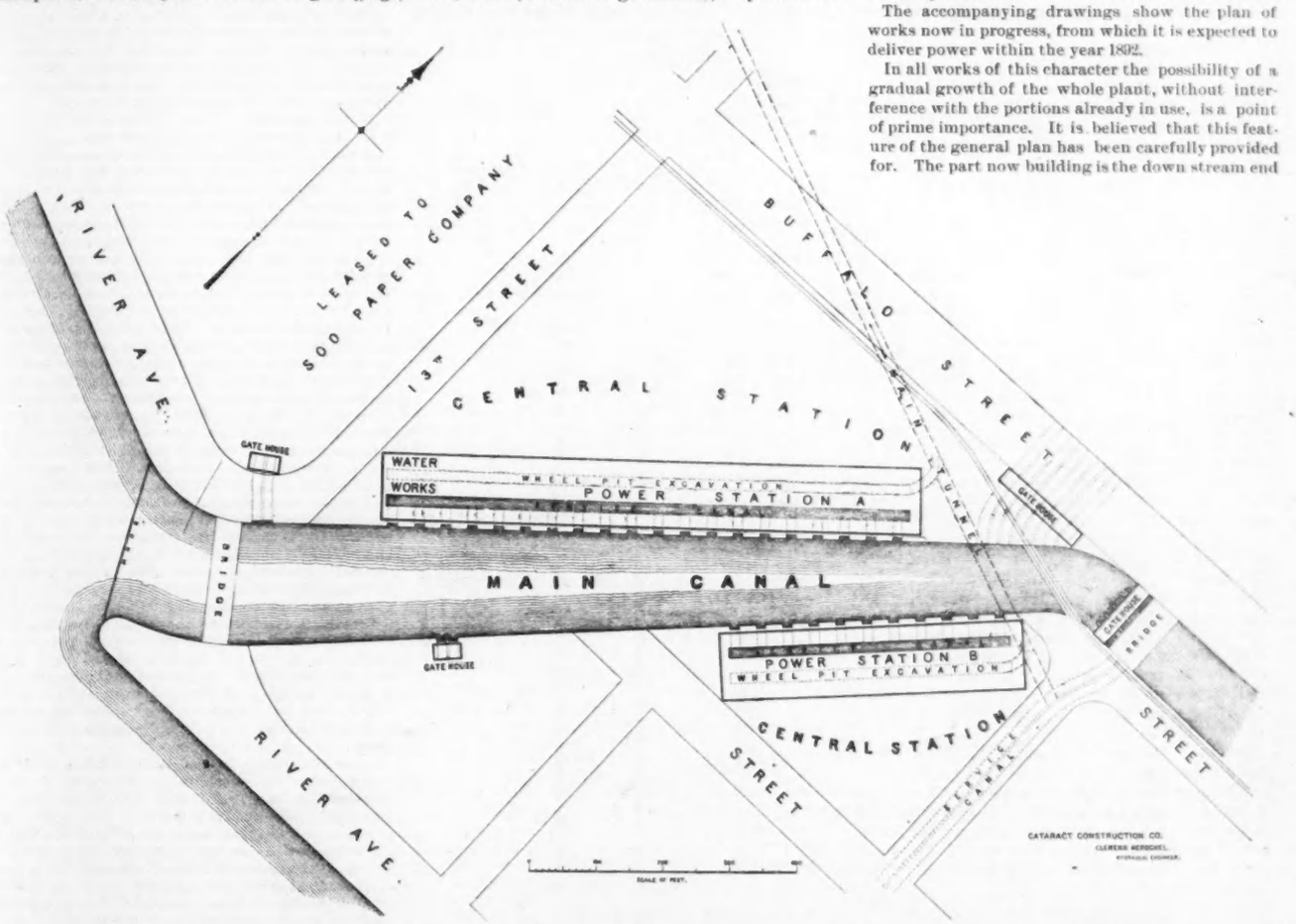


FIG 2. DETAIL PLAN OF LOWER REACH OF WATER POWER CANAL, SHOWING PROPOSED POWER STATIONS AND WATER-WORKS

which would have been required for the ordinary method of utilizing the power of Niagara Falls to any material extent, the project has appeared impracticable. Every year several of the thousands of visitors to the Falls have had the idea originate within them that a fortune could be made in creating a great water power at Niagara Falls; and as many times has a closer study of the situation revealed the practical difficulties of the situation. The neighborhood of the falls was too valuable to be bought up secretly in large blocks, or else was held by parties who would not sell; and no rights of eminent domain existed to aid in acquiring the needed lands.

At last, in 1886, was chartered the "Niagara River Hydraulic Tunnel Power and Sewer Co., of Niagara Falls, New York," composed of citizens of the village of Niagara Falls, who proposed to operate on the plan of Mr. Thos. Evershed, civil engineer. This plan was, in the main, to carry the fall of Niagara River, from below the falls, back to a district along the shores of the upper Niagara River, by means of a tunnel about 1¼ miles long; thus forming a main tail race, to be used jointly by all the mill sites; and placing these mill sites outside of the settled portion of the neighborhood, in a locality where the presence of several farms gave opportunity to purchase

of the main canal, between the river and Buffalo St. A floating boom to help keep out ice will cross the mouth of this canal; and the ice entering nevertheless is to be discharged into the tunnel. At a later stage of the works the water is to enter that portion of the canal which runs parallel with Buffalo St., from the upstream end. A gate house is projected at the present temporary end of the piece of canal now building, and another at the up stream end of the main canal. Works intended to run without intermission are to draw water outside of the gate houses; while the main canal, between the two gate houses, is to supply power to ordinary manufactories, and can be drawn off in the usual manner to facilitate repairs. To run out ice, the down stream gate house is to be opened, giving a fall of some 2 ft. on the length of the main canal for the purpose named.

Ordinarily the down stream gate house will be shut, and the water will enter the lower reach of the main canal directly from the river, as it is to enter the portion of canal now building.

On this lower reach of the main canal are located two central power stations, for the transmission and distribution of power to more distant points. Here, also, is located the site for the water-works of the future city. The plan of these works contemplates

taking the pure waters of the upper Niagara River outside of Grass Island and pumping them to a suitable stand-pipe. This portion of the works is shown on a larger scale in Fig. 2; and these stations, again, are so designed, that they are capable of future extension without interruption to the portion then in service; and without having to fight against water. For this purpose a service canal parallels the main canal, which can be temporarily cut off, at intervals, by stop-plank. The front wall of the main canal is also provided with stop-plank at frequent intervals, in the shelter of which, future connections with the service canal and other extensions and improvements can be constructed.

As has been observed, the plans adopted permit of a utilization of power by developing power either (1) on the several mill-sites, or (2) in central power stations, thence to be transmitted to mill-sites, or (3) contemporaneously by both methods, as commercial considerations may from time to time decide. Fig. 3 shows a plan that has been drawn for the hydraulic machinery to drive the pneumatic transmission plant of a central power station. At time of writing this, the plans for an electric central power station are being prepared.

The Niagara Falls Power Co., intends to build its own terminal railway, to receive and deliver cars from any railway reaching Niagara Falls to any mill site; thus avoiding at the outset, that pernicious system of rivalry for freight business, which has built two or even three tracks in many manufacturing cities that could be named, where one track would have been ample, and which has consequently done grievous injury to the inhabitants of these cities, who see the streets needlessly cut up by tracks, to the manifest disadvantage and danger of travel, and who, in the end, must nevertheless pay for all the superfluous tracks, no less than for the useful ones.

Besides railway transportation, lake transportation and transportation on the Erie Canal are available to tenants of the Niagara Falls Power Co. Many of the mill sites front on the upper Niagara River, and may be reached by lake vessels. The complete plan contemplates also the entry of canal boats into the main canal, and a system of freight tracks on the side of this canal.

From many points of view, the enterprise here described may be considered as one of the most notable of those undertaken in these closing years of the 19th century, itself notable for great undertakings. It is a credit to the men and to the nation that have conceived it, and to those who are engaged in its development.

THE MANAGEMENT OF MUNICIPAL PUBLIC WORKS IN ST. LOUIS.

If there be a point in which our political methods and system of government has proved gravely defective, it is beyond question our methods of city administration. We all hope, and most of us believe, that this is only a temporary evil, due for the most part to the steady influx of uneducated foreigners who herd in our cities and are there easily controlled for base uses; but for the present at least it is beyond question that most of our cities are ill governed, especially in respect to the streets and public works.

To this rule, however, St. Louis has been for many years past a bright exception. It has deviated from general practice in two important respects, which may or may not stand to each other in the relation of cause and effect, but which cannot be denied. First, it has placed the management of all its public works in the hands of a non-political board of expert engineers, each having some separate department of his own, but all acting together in some measure as a board. Secondly, its public works for many years past have been better managed and executed, at less cost, than in most other cities.

Mr. Robert Moore, M. Am. Soc. C. E., who has been from the beginning a member of this board, and who is already known by reputation to most of our readers, has rendered a great service to the public and the profession of engineering by preparing a paper giving a history and description of this peculiar feature of St. Louis' city administration, which was read on 18th inst. before the Boston Society of Civil Engineers. In view of its unique value and interest, we reprint this paper in full below.

Nothing more distinguishes the city of to-day from the city of former times than its great and ever growing

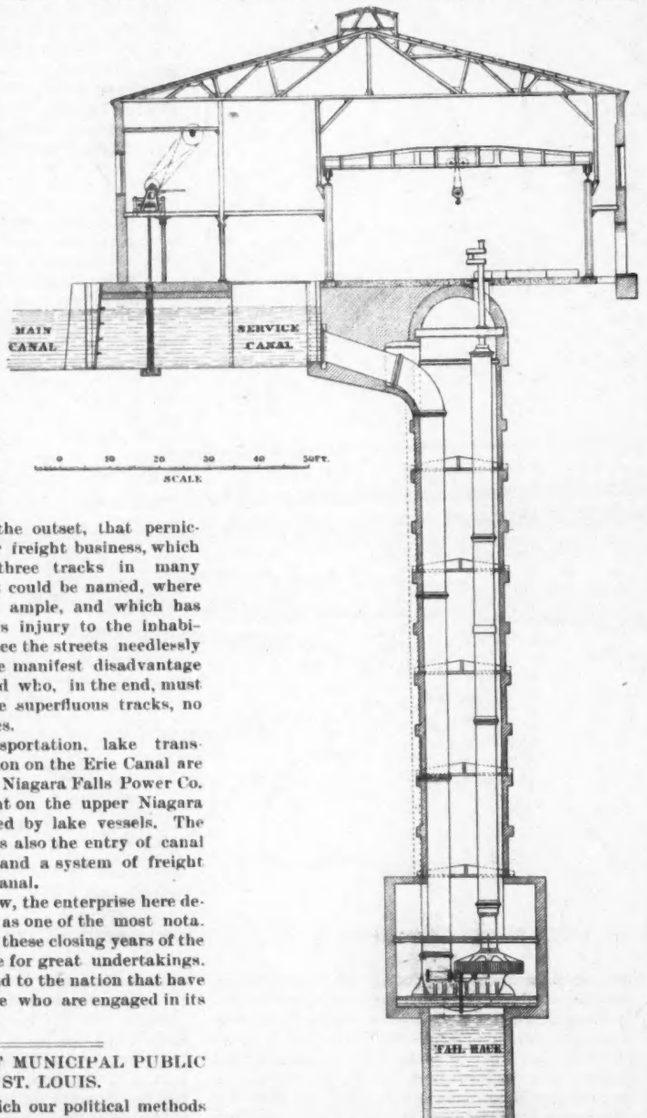


Fig. 3. Section Showing Proposed Hydraulic Machinery for a Central Power Station, Niagara Falls Water Power Tunnel.

dependence upon engineering works. The cobblestone pavement of the ancient town is replaced by granite and concrete and the iron tramway. Underneath the surface is now found an intricate network of water pipes, gas pipes, electric conduits and sewers, upon whose right working depend the city's life and health; whilst its commerce is dependent upon harbors and bridges, telegraphs and railways, which it has been the work of a generation of engineers to construct. Modern city government is in large measure a matter of municipal engineering, and that city is governed best in which this work is carried on with the greatest skill and success. As a contribution to the study of this most important branch of city government, a statement of the somewhat exceptional experience of the chief city of the Mississippi Valley in this line of work is worthy of record.

In 1875, Missouri adopted a new constitution, in which was engrafted a provision authorizing the city of St. Louis to enlarge its boundaries, abolish the dual and often conflicting government of city and county, and conduct its local affairs in accordance with a charter to be framed by its own citizens.

In pursuance of this provision there assembled, in the spring of the following year, a board of 13 freeholders, chosen by the people, charged with the duty of framing a new city charter. The board contained a number of able and public spirited men, skilled in city affairs, and, as a whole, exceptionally well fitted for its work. At the end of the 90 days, to which by law their deliberations were limited, they submitted for approval by popular vote a charter which was, in many of its features, a new departure, particularly in the machinery for the conduct of the city public works. The charter thus framed was ratified by the people; and on Oct. 22, 1876, became the organic law of the city. In order to make clear the changes in the machinery and methods of municipal engineering effected by this new law, it is necessary to explain how this work was done prior to this time.

The charter of 1870 and the ordinances in force in 1876 created a department of the city government, styled "The Engineer Department," in charge of an officer called the city engineer. This officer was appointed by the mayor, subject to approval of the city council, for a term of two years, the same as that of the mayor, and at the same salary, $4,000 a year. Like other appointed officers, he was subject to removal or suspension by the mayor, with no restriction except that he must report the facts of the case to the city council at its next meeting. The city engineer was, by the charter, required to be "a thorough, practical and experienced civil engineer," and, with the aid of such assistants, clerks and agents as should be required, was to have charge of "all city improvements, works, repairs and buildings, and the performance of all contracts for the same." He was also required to let all contracts for public work, such lettings to be duly advertised and the work awarded "to the lowest and best bidder." The council was expressly forbidden to let any public work, or to fix the price or rate therefor.

The engineer was also authorized, with the approbation of the mayor, to employ his own subordinates, and, subject to the same approval, to dismiss them whenever, in his opinion, the interests of the city would be subserved thereby, and to employ other persons in their stead. The ample jurisdiction thus granted to the city engineer over "all city improvements, works, repairs, and buildings, and the performance of all contracts for the same" was, however, subject to important qualifications. First of all, he had nothing whatever to do with the city water-works, the entire control of which in all its departments was, by special statute (March 13, 1867), vested in a Board of Water Commissioners, composed of three men appointed originally by the Legislature, and subsequently by the mayor. This board employed its own chief and assistant engineers, who were wholly independent of the city engineer.

In the second place, in the department of sewers he had only a limited and subordinate jurisdiction. By an ordinance dating back to 1859 (Ord. 4,535, Nov. 25, 1859), this department was placed in charge of a committee of the city council styled "the sewer committee," of which the city engineer was the chief executive officer, but not a member. This committee fixed the boundaries of sewer districts, decided upon plans, directed the letting of work, granted permits for sewer connections, passed upon the employment and discharge of all men employed in the department, and certified all bills involving the expenditure of money. The city engineer attended all meetings and kept the journal of the committee. He made estimates of work done, and, upon the completion of district sewers, certified the special tax bills upon the property drained. He made plans for the committee; but in the final decision upon them was without a vote. In all work of this class he had no power to carry out the instructions of the sewer committee.

In the protection and improvement of the harbor, and in the construction, repair, and cleaning of streets, his powers were more ample, and these were, in consequence, the chief fields of his activity.

The changes in the organization of the city government made by the charter of 1876 were numerous, and some of them quite radical. The number of wards was increased from 12 to 28 and the city legislature, or "Municipal Assembly," enlarged from one to two houses, called respectively the Council and House of Delegates. The Council was composed of 13 members, elected for four years on general ticket; the House of Delegates, of 28 members, one from each ward, elected for two years. The powers and duties of the mayor were left substantially unchanged, but his term of office, with that of all other elective or appointive offices, was increased to four years. The term of all elective officers was made coincident with that of the mayor, but the term of all appointive officers was made to extend from the middle of one mayor's term to the middle of his successor's term; so that, nominally, no appointments were to be made by any mayor until the beginning of his third year in office.

Most sweeping of all, however, were the changes in the

organization of the municipal public works. By the new charter the offices of the city engineer, the sewer committee and the board of water commissioners are abolished, and in their stead is established a wholly new body, styled the board of public improvements, to the members of which, acting in part jointly, and in part singly, is committed the management and execution of all the city works.

This body is composed of a president, elected by the people, and five commissioners, appointed by the mayor with the approval of the Council. These commissioners are styled, respectively, the street commissioner, the water commissioner, the sewer commissioner, the harbor commissioner and the park commissioner. In case the city should acquire the city gas works, a further member of the board, entitled the gas commissioner, is provided for.

As individuals, each of these five commissioners is, by the charter and ordinances in pursuance thereof, made the executive head of the department indicated by his official title, and, as such, is charged with the execution of all contracts, and the enforcement of all ordinances relating to his department, and is responsible for all the acts of his subordinates. As part of this responsibility all of his subordinates are appointed by the commissioner' part of them subject to the approval of the mayor, and part subject to the approval of the president of the Board of Public of Improvements, and all of them are removable by him at his pleasure. Each commissioner may himself be removed by the mayor or by the Council for cause; but if removed by the mayor, the Council appoints his successor; if removed by the Council, his successor is appointed by the mayor without concurrence of the Council.

The president of the board in his official capacity is head of the "Special Tax Department," and as such must make out and sign all bills of special assessment for street and sewer construction, and for street sprinkling. The Department of Public Buildings, though in immediate charge of a a commissioner of public buildings, is also under the supervision and control of the president of theboard. He is also charged with a general supervision over the departments of the other members of the board, and it is made his duty to inform the mayor and Municipal Assembly of any dereliction of duty of any commissioner.

To the Board of Public Improvements, acting as an organized body, is committed:

First. The letting of all contracts for public work and the preparation of specifications and forms of contract therefor. A carefully drawn ordinance, prepared by the board, prescribes the rules to be observed in all lettings. The award, if any, must always be made to the lowest bidder, and the contract, when executed, is subject to the approval of the Council.

Second. The preparation and recommendation to the Assembly of ordinances for the following classes of public work:

1. For the opening, widening, construction, reconstruction, repairs and sprinkling of streets, and the making ing of all excavations therein.

2. For the establishment of sewer districts, and for the construction, repair and cleaning of all public and district sewers, and the making of all sewer connections.

3. For the laying of water pipes, and the making of all attachments thereto, as well as the extension, construction and repairs of the water works.

4. For the improvement, protection, repairing and cleaning of the levees, wharf and harbor.

5. For the improvement and maintenance of the public parks, and

6. For the erection, extension and repairs of public buildings.

In this matter of the preparation of ordinances for public work, the board is in effect a third branch of the city leg slature. With regard to street and sewer work, the charter, in fact, provides that no ordinance shall be valid unless first approved by the Board of Public Improvements.

As a preliminary to the preparation of ordinances for street construction or reconstruction, the board is required to give two weeks' public notice of its intention to consider the matter, at which meeting all parties interested may appear and be heard in regard to it. If the owners of a major part of the property on the line of the proposed improvement shall remonstrate against the same, no ordinance therefor can be forwarded by the board, except by the concurring vote of all its members, otherwise a majority vote only is required.

Third. A further duty of the board is the direction and management of the lighting of streets, alleys and public buildings, which is now done wholly by electricity. The superintendent of city lighting is an appointee of the board and subject to its orders.

Fourth. To the board also is committed the management and control of the city workhouse, the superintendent of which, though appointed by the mayor, is subject to the orders and instructions of the board.

The board is required to meet at least once in each week and to keep a record of all its proceedings, acts and orders, an abstract of which must be published in the newspapers doing the city printing.

Owing to the delays of various kinds, the machinery thus outlined did not get into working order until the summer of 1887, when the organization of the new board was completed under the presidency of Col. Henry Flad, Past President American Soc. C. E. With the single exception of the water commissioner, the late Thos. J. Whitman, who had been the Chief Engineer of the Board of Water Commissioners, the new commissioners, of whom the writer was one, were without previous experience in the special departments over which they were called to preside; but all were animated by an earnest desire so to organize and conduct the work committed to their charge as to secure the best possible results and establish the new regime in the confidence of the people.

That they were successful is, so far as the writer is aware, the unanimous verdict. The public works of the city have been managed with economy and skill, and without the slightest suspicion of jobbery. City work is in fact as well and as honestly done as that of any private individual or corporation; so that in cases where an option is given to the property owner, to do the work, such as sidewalk or alley paving, himself, or to have it done by the city at his expense, it is found to be uniformly cheaper and better to have it done by the city.*

The full control and responsibility given by the new system to each commissioner over his own department has naturally placed integrity and fitness at a premium in the appointment of subordinates, to the disregard of political and other irrelevant considerations. Each has been free to organize and manage his force with an eye single to obtaining the best work, both in quantity and quality, and where this is done success is easy and certain.

Another thing which has contributed much to the efficiency of the various departments, has been the opportunity of the commissioners to refer doubtful points of policy to the full board for advice and counsel. Backed by the prior indorsement of the board, they are thus enabled to take with safety responsibilities which they could not otherwise do without great danger of misconstruction, and consequent loss of public confidence. For a public officer must not only do right, but must also be thought to do so by the community whom he serves. In matters of doubt the confidence of the public is more easily retained by a board than by any single man; just as a full bench of judges is stronger against calumny than any single judge, however pure his motives may be. There has thus resulted for the various commissioners a great gain in the confidence of the public, with a corresponding gain in the efficiency of the several departments.

As regards the matters committed to the board as a whole, it may be noted, first of all, that under the new system the letting of contracts for public work is conducted in a manner that leaves nothing to be desired. Every precaution is taken to put all bidders upon an equal footing. The character and quantities of the work are ascertained with the utmost care, and given in advance to all persons interested. All bids must be made upon blanks furnished by the board, and no bid is accepted unless accompanied by a certificate of the city treasurer that earnest money, amounting in some cases to 10% of the estimated value of the work, has been deposited with him. At the hour appointed the bids are all opened and read in a public meeting of the board. After a due time in which to canvass the several bids, the award, if any, is made to the lowest bidder, not the lowest and best bidder, as under the former charter; but the board may, if it sees fit, reject all bids and order a new letting.

As heretofore carried out, this system of letting public work has given universal satisfaction, without even the slightest suspicion of favoritism or jobbery. That is to say, one of the most fruitful sources of municipal misrule has been completely removed.

In its legislative functions, the success of the Board of Public Improvements has been equally pronounced. The ordinances for public work recommended by them have been prepared with great care, so that when sent to the Municipal Assembly they have embodied the results of the best skill and judgment of every member of the board. Where ordinances originating with the board have been rejected by the Assembly, it has never been because of any defect of form or method, but because of their unwillingness to do by any method the thing proposed. There can be no doubt that the provision requiring the Assembly to pass or reject without amendment bills originating with the board has insured the city against technical blunders which would otherwise certainly have been made, and is eminently wise.

The wisdom of the framers of the St. Louis charter of 1876 has, therefore, been fully vindicated by the test of time; and the general plan of conducting municipal engineering work proposed by them is one which can be recommended without reserve to any large city.

The central ideas of this plan are:

1. The subdivision of the engineering work of the municipality into several departments, under the executive control of one man, who should be a man of strong character and mature judgment, and an expert in the special work under his charge.

2. The creation of a Municipal Engineering Council, or board of experts, composed of the heads of the several engineering departments, co-ordinated under the presidency of an engineer of high rank, to which board all questions concerning the administration of the city works, may be referred, and to whose special charge should be committed the letting of all contracts for public work, and the initiation of all legislation concerning the same.

The particular method adopted in carrying out this general plan should be suited to the local requirements of each city. The one adopted in St. Louis does not seem to be quite the best, even for that city. It would be better, in the writer's judgment, to leave out from the board the Park Commissioner and Harbor Commissioner, a very small part only of whose work is of an engineering character, and in their places put the Commissioner of Public Buildings, or City Architect, and the Commissioner of City Lighting, under whose charge should be placed the supervision, in the public interest, of all electric installations.

Of course it goes without saying that neither this system nor any other will give satisfactory results if committed to the hands of incompetent or corrupt men; although it will do much, even then, to limit the harm which can be done by any one man. But, if carried out in good faith, by the selection of capable and honest men as members of the board, this method of conducting municipal engineering work has several important advantages over the older method which in St. Louis it has superseded.

1. It avoids the absurdity of expecting any one man to be master of all the branches of engineering involved in the public works of the modern city, by subdividing the work to such an extent as to make it possible for the several commissioners to give to the problems of their own special work the concentrated attention and study necessary for their complete solution.

2. By centering in one man the executive control of each department the highest degree of responsibility and efficiency is promoted.

3. By delegating to the board, composed of the heads of the several departments of public work, the preparation of all ordinances for such work, the city secures the great advantage of the matured judgment of a permanent and responsible body of experts.

4. The opportunity to present all matters of an unusual or doubtful nature to the full board, for record and for advice, is a most valuable resource and protection to the individual commissioner.

5. The placing of all lettings of public work in the hands of the board not only relieves the individual commissioners of work, in which the liability to charges of favoritism and malfeasance are the greatest, but insures the utmost publicity and fairness in the awarding of contracts, thus securing to the city the full benefits of open and honorable competition, and the services of the best class of contractors.

In a word, the system is one under which both the officer and the city are protected to the equal advantage of both, and is the best for a large city that has yet been proposed.

*An example of this came within the writer's own experience a few months ago, when, in the construction of an elevated railroad, it became necessary to move quite a length of water and gas pipes. In the one case the city water department, and in the other the gas company, was called upon to do the work at the expense of the railway company. The result was, that the work of the gas company was done at an excessive cost, due to discipline and methods so lax that the railway company was charged with time during which the workmen were employed in digging up old lead water pipes and carrying them to a junk shop for sale. The city work, on the other hand, was done promptly and well, and at a cost much less than if it had been done by the railway company itself.

A SMALL LOCOMOTIVE, MORVI RY., INDIA.

In a recent number of "Indian Engineering" is a letter from Mr. M. Burke, Locomotive and Car Superintendent of the Morvi Ry., containing a description of an engine built at the railway work shops at Morvi. The railway is about 90 miles long, and has a gage of 30 ins. The track is laid with 19 lb. steel rails on steel ties, and for a part of its length the line runs along a highway. The engine has six wheels, all coupled, and its leading dimensions and particulars are as follows:

Cylinders	8 × 14 ins.
Diameter of wheels	2 ft. 3 ins.
Wheel base	9 ft.
Boiler pressure	140 lbs.
Heating surface	274 sq. ft.
Grate area	4.75 sq. ft.
Tubes, mild steel, number	75
Tank capacity of tender	1,020 U. S. galls
Coal " "	2,240 lbs.
Weight of engine in working order	24 640 lbs.
" " and tender "	47,040 lbs.

The engine is well got up and works very satisfactorily. The workshop is a very small concern with a few machines, and the men are of the common city artisan class, with barely three years training. His Highness the Thakore Sahib of Morvi, takes a great interest in engineering, and is anxious to get all the work done at the shops. The engine cost about $3,200, which is said to be about 2000

less than the cost of a similar one from England. The inside firebox is of Lowmoor iron, with iron staybolts, and the boiler was tested with cold water to 220 lbs. per sq. in. A Burke feed water heater is used reducing the fuel consumption and increasing the evaporation per pound of fuel. The coal consumption is 15.25 lbs per train mile, and the evaporation 10.10 lbs. per lb. of coal. The oil consumption is 5.1 lbs. per 100 miles, including cylinder lubrication. The engine will haul a train load of 77 gross tons, exclusive of weight of cars, on a grade of 0.4% at 12 miles per hour. The engine was turned out in March, 1891, and up to November, 1891, had run 10,000 train miles, or an average of 46 miles per day, working the mixed and freight trains.

LAYING A SUBMERGED WATER MAIN AT OSKALOOSA, IA.

The following description and view of the laying of a water main across a river at Oskaloosa, Ia., for the Oskaloosa Water Co. were furnished by Mr. G. W. Pearsons, Consulting Engineer, of Kansas City, Mo. A line was first stretched in the position to be occupied by the pipe line, and a temporary foot bridge built with trestles clearing the line about 2 ft. This enabled accurate soundings to be taken, and from these a profile was made on which the pipe was so located as to conform to the shape of the river bed. Such specials as were required for this purpose were cast at a local foundry. The pipe was distributed on the foot bridge and more trestles made, one end of which rested on the bottom of the river and the other on the foot bridge, giving room to swing the pipe under them. To lower the pipe long rods of ¾-in. iron were used. These had eyes at the lower end and were threaded in an ordinary bolt cutter. Wrenches to turn the nuts were made of round iron, split and opened in the center. The pipe lengths were lashed with small rope. Some pieces being put together over the deepest water were lowered a measured distance, more added and again lowered (see view). To insure equal descent at each lowering strings were tied around the bolts at uniform heights above the nuts. A man was stationed at each bolt and the lowering was done by all turning together by call. Pipes were added in this manner till the whole line was together, the final lowering to the bed showing less than an inch of variation in the whole pipe line. The weight put upon the bolts averaged about one ton each. The whole work was done without trouble by common laborers.

LAYING A WATER MAIN ACROSS RIVER AT OSKALOOSA, IA.; G. W. Pearsons, Consulting Engineer.

STATISTICS SHOWING THE MILEAGE OF RAILWAY TRACK LAID IN THE UNITED STATES DURING THE CALENDAR YEAR OF 1891.

[With Map No. 40.]

The following list includes the track laid during 1891 on extensions of steam railway lines in the United States and Canada on which regular trains are, or are to be, run, to do business as common carriers of both freight and passenger traffic; thus excluding sidings, double tracking, lumber or mining branches not carrying passengers, and city lines for passenger traffic only.

NEW ENGLAND.

Maine.

Phillips & Rangeley.—End of '90 track to Rangeley	5.
Wild River Lumber Co.—Gilead to Hastings	3.5
Total	8.5

New Hampshire.

Concord & Montreal.—North Weare to Henniker	6.
In town of Jefferson	2.65
Franklin & Tilton.—End of '90 track to Tilton	1.
Total	9.65

Vermont.

Bristol.—New Haven to Bristol	6.26
Hoosac Tunnel and Wilmington.—Readsboro to Wilmington	13.5
Total	19.76

Massachusetts.

Brookline & Pepperell.—Groton, north	2.
Old Colony.—Walpole Jc. to Norwood	5.76
Total	7.76

Rhode Island.

Woonsocket & Pascoag.—Nasonville to Harrisville	4.
Total for New England States, 10 lines built by 9 companies	49.67

MIDDLE.

New York.

Aldironack & St. Lawrence—Poland north	4.
Remsen north	15.
International line to 1 mile south of Malone	11.
Tupper Station, northeast	15.
Dutchess County.—Poughkeepsie to Hopewell	12.
Lake Champlain & Moriah.—Minerville to Fisher Hill	2.
Lehigh Valley.—Geneva to to Buffalo	101.5
Van Ettenville, North	5.0
East Rush toward Rochester	8.0
Total	173.5

New Jersey.

Caldwell.—Great Notch to Caldwell	4.5
Lehigh Valley.—On Newark meadows and in Jersey City	5.93
Lansdown to Pittston	4.02
Pennsylvania.—Alloway to Quinton	4.2
N. Y. Bay R. R. Ex	1.74
Kensington & Tacony R. R.	0.69
Philadelphia & Reading.—Bound Brook toward New York Harbor	10.
Chews Landing to Spring Mill	4.6
Philadelphia & Seashore.—Tuckahoe to Sea Isle City	10.
Raritan River.—Branch to clay pit	1.
Rockaway Valley.—Peapack to Mendham	6.
Total	52.68

Pennsylvania.

Allegheny & Kinzua.—Morrisons to Town Line	14.
Altoona & Wapsonoock.—Altoona to Highland	7.5
Baltimore & Ohio.—Branch to quarries	3.
Beech Creek.—Grass Flat to Moravian	4.5
Kerrmore to Friendship Tunnel	1.
Clarion River.—Arrayo to Hailton	6.
Delaware, Susquehanna & Schuylkill.—Between Drifton & Oneida, with branches	39.
Emporium and Rich Valley.—Emporium to Rye Run	8.
Gettysburg & Chambersburg.—Conocoheague to Wolf Hill	10.
Glen Hazel & Shawmut.—Glen Hazel to Beardsley	6.
Lackawanna & Montrose.—Montrose to Montrose Station	10.48
Lehigh Valley.—West End Extension (Allentown)	0 14
West Side Connecting (Wilkes Barre)	4.37
Thorndale Branch	5.77
Loyalsock Branch	1.55
Mahoning Valley.—Stanley to Helvetia	2.
Mt. Carmel & Natalie.—Mt. Carmel to Natalie	6.
Newport & Sherman's Valley.—Elliotsburg to Blain	13.
Pennsylvania.—Glen Loch to Morrisville, N. J	45.
South Fork Sta. to Dunlo	7.98
Stewart to Murrysville	6.5
Cochran Sta. to McKeesport	1.47
Pencoyd Branch	1.28
Extension Clearfield Branches	8.23
Turtle Creek Branch	2.02
West Penn. R. R. Branches	9.54
Marginal R. R., Beaver Falls	2.96
Miscellaneous extensions	2.33
Perry County.—New Bloomfield to Nelsons	4.
Philadelphia & Reading.—Bowmansdale to Harrisburg	8.10
Lofty to D., S. & S. R. R.	10.
Pittsburg & Moon Run.—Groveton to Moon Run	5.
Pittsburg, Shenango & Lake Erie.—Harmonsburg to Wallace Junc	28.5
Erie Junc. to Erie	2.5
Cranesville to E. & P. Crossing	2.
Sinnemahoning Valley.—At Costilio	1.
Sugar Run.—Between Sugar Run Junc. and Sugar Run Sta	6.
Wilkesbarre & Western.—Rohrsburg to Orangeville	3.
Total	299.57

Maryland.

Gunpowder Valley.—Hoffman to Hoffmanville	3.
Total for Middle States, 56 lines built by 30 companies	28.75

NORTH CENTRAL.

Ohio.

Baltimore & Ohio.—Between Akron and Chicago Junction	44.5
Cleveland, Cincinnati, Chicago & St. Louis.—Ivorydale to Carthage	1.
Cleveland, Wooster & Western.—Wooster to Lodi	20.
Findlay, Ft. Wayne & Western.—Glendorf to M. & E. Canal	14.25
Middletown & Cincinnati.—End of '90 track to King's Station	12.
Norfolk & Western.—Coal Grove to Kenova	7.8
Pennsylvania.—Pittsburg, Youngstown & Ashtabula R. R.	5.88
Miscellaneous extensions	2.33
Pittsburg, Akron & Western.—Rocky River to Akron	16.
Pittsburg, Ohio Valley & Cincinnati.—Station 222 to Station 590	7.
Toledo, Columbus & Cincinnati.—Kenton to Ridgeway	9.4
Sandusky & Columbus Short Line.—Sandusky to Bellevue	12.55
Zanesville Terminal.—South Zanesville to C., S. & H. Junc	1.4
Fair Grounds to C. & C. Junc	2.
C. & M. V. Junc. to Belt Line Junc	0.4
Total	156.46

Michigan.

Chicago & West Michigan.—Traverse City toward Charlevoix	25.
Charlevoix toward Petoskey	16.
Elk Rapids to Williamsburg	8.
Flint & Pere Marquette.—Redford Junc. to Delray Junc	8.5
Manistee & Grand Rapids.—Big Sauble toward Luther	12.63
Manistee & Northwestern.—Lake Ann to Cedar River	5.48
Milwaukee, Lake Shore & Western.—Little Falls northwest	9.29
Branch South	3 47
Total	88.37

Indiana.

Ft. Wayne, Terre Haute & Southwestern.—Carbon to Mansfield	10.5
Louisville, Evansville & St. Louis.—Around City of Princeton	2.5
Ohio & Mississippi.—Lewistone to Mitchell Hollow	1.42
Pennsylvania.—Grand Rapids & Indiana R. R.	4.09
Total	18.51

Illinois.

Belleville & St. Louis.—East St. Louis to Belleville	3.5
Centralia & Chester.—Oakdale to Nashville	8.75
Chicago & Eastern Illinois.—Tuscola to Shelbyville	41.
Chicago & Northern Pacific.—Blue Island to Chicago	10.
Elgin, Joliet & Eastern.—South Aurora to Aurora	1.25
Illinois Central.—Clyde to Chicago	9.16
Pawnee.—St. L. & C. R. R. to Auburn	5.
Total	78.66

Wisconsin.

Kewaunee, Green Bay & Western.—Kewaunee to Green Bay	33.
Kickapoo Valley & Northern.—Wauzeka to Soldiers' Grove	35.
Milwaukee, Lake Shore & Western.—Wausau to Marshfield	40.58
Port Edwards, Centralia & Northern.—End of '90 track to Marshfield	10.
Wisconsin Central.—End of track to Greenwood	17.5
Total	136.08
Total for North Central States, 41 lines built by 33 companies	478.02

SOUTH ATLANTIC.

Virginia.

Bristol Belt.—Around Bristol, Tenn	5.
Chesapeake & Ohio.—Bessemer to Craig City	16.5
Covington to Hot Springs	25.
Glasgow Belt.—At Glasgow, Va	6.
Louisville & Nashville.—End of '90 track to Norton	38.
Norfolk & Western.—End of '90 track to Norton	8.7
Roanoke Belt Line R. R.	1.8
Mine Bank Branch	2.9
Russell Creek Branch	1.3
Roanoke & Southern.—North Carolina line to Roanoke	75.7
Total	190.9

West Virginia.

Huntington & Big Sandy.—Huntington to Twelve Pole River	6.
Norfolk & Western.—Kenova to Boissevain, Va	48.2
Elkhorn to Hallsville	21.5
Ohio River.—New Era to Spencer	25.
Snowey Creek.—Rinard to Cranesville	10.
West Virginia & Pittsburg.—Burnesville to Sutton	18.4
Alton to Norton	7.
Gauley Junc. to Elk River	8.
West Virginia Central & Pittsburg.—Elkins to Belington	17.5
Junction to Beverly	5.5
Wheeling Bridge & Terminal.—Wheeling to Martin's Ferry	5.5
Total	172.1

North Carolina.

Atlantic Coast Line.—Fayetteville toward Rowland	21.25
Rowland toward Fayetteville	8.75
Lower Creek & Linville Valley.—Lenoir to Nelsons	7.5
Richmond & Daville.—End of '90 track to Norwood	17.
Winston to Mocksville	26.7
End '90 track to Murphy	9.2
Seaboard & Roanoke.—Pendleton to Murfreesboro	6.5

Wilmington, Chadbourn & Conway.—End of '90 track to Hub ..... 9.
Wilmington, Onslow, & East Carolina.—In city of Wilmington 0.24

Total 106.14

South Carolina.

Ashley River.—Ashley Junc. to Ashepoo Phosphate Works 4 5
Bishopville.—Bishopville to Lucknow ..... 8.
Blackville, Alston & Newberry.—Barnwell to Allendale ..... 17.
Branchville & Bowman.—Branchville to Bowman .. 11.
Carolina, Knoxville & Western.—Extension to Marietta 2.25
Charleston, Sumter & Northern.—Sumter to near Bennettsville 56.3
Columbia, Newberry & Laurens.—Jalapa to Dover .. 13.5
South Bound.—Savannah River to Columbia ..... 107.

Total 219.55

Georgia.

Abbeville & Way Cross.—Bowen's Mill to Lulaville. 5.5
Albany, Florida & Northern.—End of '90 track to Cordele ..... 15.
Chattanooga Southern.—End of '90 track to Alabama line ..... 7.
Flovilla & Indian Springs.—Flovilla to Indian Springs ..... 8.
Georgia, Carolina & Northern.—Savannah River toward Atlanta ..... 95.
Macon & Atlantic.—Mile post 58 to mile post 69 ..... 11.
Macon, Dublin & Savannah.—End of '90 track to Dublin ..... 44.
Millen & Southern.—Thrift to Mill n ..... 11.
South Bound.—Michord to Savannah River ..... 20.
Tifton & Northeastern.—Tifton to Irwinsville ..... 13.
Wrightsville & Tennille.—Extension into Dublin ... 1.

Total 230.50

Florida.

Florida Central & Peninsular.—Archer to Dunnellon ..... 30.
Florida, Georgia & Western.—Tallahassee to Lake Como 11
Gainesville, Rocky Point & Micanopy.—Gainesville to Micanopy 12
Silver Springs, Ocala & Gulf.—Dunnellon to Inverness ..... 18.
South Florida.—Branch to Phosphoria 7.5
Suwannee River.—Louisville Southeast 3.5

Total ..... 82.
Total for South Atlantic States, 53 lines built by 43 companies 1,001.19

SOUTH CENTRAL.

Kentucky.

Kentucky Union.—Elkatawa to Inverness ..... 4.
Middlesborough Belt.—Branch up Stony Fork 3.96
Ohio & Big Sandy.—Richardson to Big Sandy Bridge 16.
Richmond, Nicholasville, Irvine & Beattyville — Richmond to Irvine ..... 22.

Total 45.96

Tennessee.

Bristol Belt.—Around Bristol ..... 5.
Bristol, Elizabethton & North Carolina —S., A. & O. R. R. to Main St., Bristol 1.5
East Tennessee, Virginia & Georgia.—Dorr's Mills to Embreeville ..... 11.
Harriman Coal & Iron.—Rolling Mill station to stone quarries, near Harriman 1.25
Louisville & Nashville.—Pond station to Van Leer .. 11.
Van Leer to Cumberland Furnace ..... 6.
Hematite to Marion ..... 14.
Louise to Raimey 1.3
Morristown & Cumberland Gap.—Morristown to Corrytown ..... 44.
Middlesborough Belt.—Bennett's Fork to coal mines 0.77
Nashville & Knoxville.—Cookville to Chimney Springs ..... 7.
Paducah, Tennessee & Alabama.—Hazel to Hollow Rock 38.6
Tennessee Midland.—In city of Memphis 2.5
Wautauga Valley.—Wautauga toward Wautauga Point 1.1

Total 145.02

Alabama.

Central R. R. of Georgia.—Troy to south of Searight ..... 40.
Chattanooga Southern.—Georgia line to 12 miles north of Gadsden ..... 40.
Louisville & Nashville.—Belt line at Decatur ..... 2.
Obatchie Valley.—Burnesville to mines 2.5
Savannah, Americus & Montgomery.—Chattahoochee River, west ..... 14.
Huntsboro to Montgomery ..... 56.
Tennessee & Coosa.—End of '90 track to Guntersville 4.24
Treadgar Mineral.—Jacksonville to Treadgar Junc. 3.

Total 161.74

Louisiana.

Kansas City, Watkins & Gulf.—Mile post 10 to mile post 60 ..... 50.
Louisiana Nickel Plate.—Veline to Allentown 2.5
Louisville, New Orleans & Texas.—Latcher to mills 6.
Missouri Pacific.—Riverton to Alexandria 72.5
New Orleans, Ft. Jackson & Grand Isle.—Socola to Buras 19.6
Socola to Graud Bayou 1.4

Total ..... 153.
Total for South Central States, 30 lines built by 25 companies ..... 500.

SOUTHWESTERN.

Missouri.

Kansas City, Nevada & Ft. Smith.—Amoret to Hume 12.
Mississippi River & Bonne Terre.—Bonne Terre to Doe Run 15.1
Montgomery & Western.—Montgomery west 2.5

Total 29.6

Arkansas.

Hope & Louisville.—Louisville toward Hope ..... 7.
Mississippi & Little Rock.—End of '90 track to Ross. 24.
Missouri Pacific.—Camden to El Dorado 32.5
Prescott & Northwestern.—Prescott to Wallaceburg 7.
St. Louis Southwestern.—At Argentia 1.5
Texarkana & Ft. Smith.—Tullock to Ashdown ..... 10.

Total ..... 82.

Indian Territory.

Choctaw Coal & Ry Co.—End of '90 track toward Oklahoma City 5.76

Texas.

Bonham Rapid Transit.—Station to Fair Grounds... 3.
Ft. Worth & Rio Grande.—Comanche to 2½ miles west of Brownwood 33.8
At Ft. Worth 2.5
Hearne & Brazos Valley.—H. & B. O. Junc. to Mumford ..... 9.
Missouri, Kansas & Texas.—Milford to Hillsboro 14.8
San Antonio & Aransas Pass.—Lexington to Lott... 57.9
Texas, Louisiana & Eastern.—Conroe east ..... 8.
Velasco Terminal.—Velasco toward Hernando .... 6.

Total ..... 125.

Kansas.

St. Louis & San Francisco.—Weir City to near Scammonville 1.39

Colorado.

Denver & Rio Grande.—Wagon Wheel Gap to Creede 9.59
Denver, Lakewood & Golden.—Denver to Golden 11.5
Golden north 0.5
Rio Grande Southern.—Vance Junc. to Porters Mill. 121.
Telluride to Pandora 2.25

Total 144.84

New Mexico.

Silver City & Northern.—Whitewater to Hanover 18.

Total for Southwestern States, 25 lines built by 22 companies 406.59

NORTHWESTERN.

Iowa.

Chicago, Ft. Madison & Des Moines.—Collett to Libertyville 4.2
Southern Iowa.—C., B. & Q. R. R. to Keb ..... 3.
Winona & Southwestern.—Minnesota line to Osage 22.06
Osage to Cedar River 1.35

Total 30.61

Minnesota.

Duluth & Winnipeg.—Compton to Crystal Lake.... 15.
White Oak Point to Bass Creek ..... 4.
Cloquett toward Duluth ..... 14.
Duluth Transfer.—In West Duluth ..... 2.
Great Northern.—Halsted to North Dakota line.... 1.33
Eagle Bend to Park Rapids ..... 55.
Winona & Southwestern.—Spring Valley to Iowa line 15.5
On Winona Bridge ..... 1.

Total 107.83

Nebraska.

Burlington & Missouri River.—Beverly to 10 miles west of Palisades 18.5
Missouri Pacific.—Union to Union Pacific Junc.... 25.5

Total ..... 44.

North Dakota.

Great Northern.—Alton to Minnesota line ..... 10.
Minneapolis, St. Paul & Sault St. Marie.—Boynton to Merricourt ..... 10.
Hankinson to Valley City 81.3

Total 101.3

South Dakota.

Burlington & Missouri River.—Mystic to Deadwood 23.45
Minnekahta to Hot Springs 12.77
Deadwood Central.—Deadwood to Ruby Basin..... 7.

Total 43.22

Wyoming.

Burlington & Missouri River.—Merino to Gillette.. 47.89

Montana.

Great Northern.—Monarch to Niehart 13.4
Monarch to Barker 10.8
99-mile post to Kalispell ..... 162.
Valley.—In Helena 1.73
Total 187.93

Total for Northwestern States, 22 lines, built by 11 companies 362.48

PACIFIC.

Washington.

Bellingham Bay & British Columbia.—Evason to Sumas 7.4
Great Northern.—Seattle to F. & S. R. R 78.4
Sedro to coal mines 5.8
Northern Pacific.—Seattle Belt Line 10.2
Olympia to Gate City 21.4
End '90 track to Elma 6.9
Montesano to Ocosta 24.5
South Aberdeen to Cosmopolis 1.6
Chehalis toward South Bend ..... 20.
End of '90 track to Sumas ..... 23.
Port Townsend Southern.—Olympia to Butler's Cove 2.7
Hooker's Lake to Quilicene 7.5
Seattle & Northern.—End of '90 track to Hamilton.. 6.
Snohomish, Skyhomish & Spokane.—Snohomish to Lowell 5.25

Total 220.75

Idaho.

Northern Pacific.—Howell to Nez Perces Indian Reservation 20.4

Oregon.

Coos Bay, Roseburg & Eastern.—Marsfield south... 10.
Oregonian.—Coburg to Natron ..... 13.
Sumpter Valley.—Baker City to Ft. Sumter 25 2

Total 48.2

California.

California & Nevada.—Orinda Park to Bryant..... 3.
Los Angeles Terminal.—Los Angeles to East San Pedro 27.0
San Francisco & North Pacific.—Near Greeneville west 1.34
San Francisco Belt.—At San Francisco 0.7
San Joaquin Valley.—Fresno to Pullaski ..... 24.
Southern California.—Asylum to Mentone 6.7
Southern Pacific.—End of '90 track to Armona ..... 59.
Arvon to San Ramon 19.7
Mound City toward Redlands 5.0

Total 146.44

UTAH.

Great Salt Lake & Hot Springs.—Salt Lake City to Centerville 11.9
Rio Grande Western.—Manti to Salina ..... 26.

Springville to Eureka ..... 40.
Union Pacific.—Silver City to mines 3.03

Total 80.93
Total for Pacific States, 31 lines built by 17 companies 552.22

CANADA.

Quebec.

Adirondack & St. Lawrence.—Valleyfield to International line 21
Lower Laurentian.—Riviere à Pere to San Tite 13
Montreal & Western.—Ste. Jerome to Ste. Adele 13
Orford Mt.—Eastman to Glen Robertson 21

Total 68

Ontario.

Grand Trunk.—Waterloo to Elmira 10.25
Extension to Port Huron tunnel ..... 5.
Ottawa & Gatineau Valley.—Wakefield north ..... 10.
Parry Sound Colonization.—Scotia toward Parry Sound ..... 20.
Port Arthur, Duluth & Western —Stanley toward International line ..... 15.
Toronto Belt.—At Toronto 8.5

Total 68.75

Manitoba.

Canadian Pacific.—Methven to Nesbitt 5.6
Hartney southwest ..... 32.

Total 37.6

Northwest Territory.

Canadian Pacific.—Red Deer River to Edmonton .... 98.
Calgary to Mosquito Creek ..... 54.

Total ..... 152.

British Columbia.

Canadian Pacific.—End of '90 track to International line ..... 8.
End of '90 track to Nelson ..... 6.
Sicamous to Okanagan Lake ..... 51.

Total ..... 65.

New Brunswick.

Temiscouata.—Cairs to Connors ..... 12.

Nova Scotia.

Central Counties.—Hawkesbury to Glen Robertson ..... 21.
Tobique Valley.—Poquemoque to Red Rapids 9.5
Torbrook Coal Co.—Wilmont to Torbrook ..... 3.

Total 33.5

The recent state irrigation convention at Helena, Mont., refused to adopt the Salt Lake City platform recommending the cession of arid lands to the several states. As a substitute it was resolved that the government should aid in irrigation development, and should at least give to the several states proceeds from the sale of such lands, the money to be applied to the supplying of water for irrigation. In the note last week, p. 58, regarding this convention the last clause should have read "a resolution had been introduced [instead of adopted] in favor of a state irrigation and immigration commission and a state engineer."

PERSONALS.

Mr. Charles W. Gay has been elected City Engineer of Lynn, Mass.

Mr. W. J. Dodge has resigned his position as superintendent of the Cheshire Division of the Fitchburg R. R., with office at Keene, N. H.

Prof. Palmer C. Ricketts has been elected director of the Rensselaer Polytechnic Institute, Troy, N. Y., vice Prof. D. M Greene, resigned.

Prof. Joseph Lovering, of Harvard, died at Cambridge, Mass., Jan. 18, at the age of 78. He was connected with the U. S. Coast Survey from 1867 to 1876.

Mr. Wm. F. Turreff, Assistant Superintendent of Motive Power of the New York, Lake Erie & Western R. R., died in New York, Jan. 17, at the age of 57.

Hon. J. A. Ouimet has been appointed Minister of Public Works for Canada, and Hon. J. G. Haggart has been appointed Minister of Railways and Canals.

Mr. J. D. McElwain, formerly in charge of the Grand Trunk Ry. car shops at London, Ont., has been appointed manager of the works of the Harvey Steel Car Co., Chicago, Ill.

Mr. E. W. Penfield has become connected with the Q. & C. Co. in the interest of the Servis tie-plate. He was for several years connected with the Chicago, Burlington & Quincy Ry.

Mr. Edwin Hawley Hunt, of Chicago, Ill., died at Minneapolis, Minn., Jan. 18, aged 21 years. Mr. Hunt was in the service of Engineering News in 1889, and more recently was in the engineering department of the Norfolk & Western R. R.

Mr. Alexander J. Davis, architect, died at West Orange N. J., Jan. 14, at the age of 87. He was architect for many public buildings, and in 1829 entered into partnership with Ithiel Town, the bridge builder. The Harlem Railroad viaduct was among his works.

Mr. Robert Stephenson, Managing Director of the engine, locomotive and shipbuilding firm of Robert Stephenson & Co., Newcastle, England, died in Italy, Dec. 21. The works were originally established by George Stephenson and his son, Robert Stephenson.

Mr. D. M. Carey, of the contracting firm of Paige, Carey & Co., New York, was killed at Wheeling, W. Va., Jan.

14. He was standing on a trestle at the stone bridge being built over Wheeling Creek, when it gave way, having been undermined by the floods, and Mr. Carey was thrown into the water, a car loaded with stone falling upon him.

Mr. E. P. Butts, Jun. Am. Soc. C. E., Resident Engineer of the Mississippi River Bridge at Burlington, Ia., was killed at the bridge Jan. 11. The masonry pivot pier is being widened for the turntable of a double track draw, and Mr. Butts was standing upon the ice-breaker when a large stone that was being removed fell upon him, crushing his skull.

Mr. Benezette Williams has been appointed chief engineer of the Drainage Board of Chicago, vice Mr. Samuel G. Artingstall resigned. Mr. Williams graduated from Michigan University in 1869, and was in railway service until 1872, when he entered the service of the city of Chicago, first in the sewer department and subsequently as assistant to Mr. E. S. Chesbrough, city engineer. He was for two years in charge of the sewer department, and acted as city engineer for a few months after Mr Chesbrough's resignation, when he also resigned in 1879 to take up private practice, in which he was associated with Mr Chesbrough until the latter's death in 1886. He designed and constructed the sanitary system for the town of Pullman, and has been connected with the drainage and water supply problems of many of the suburbs of Chicago. He was one of the Hering commission, which investigated the sanitary problem of Chicago, upon which investigation the present law was substantially based.

Prof. Palmer C. Ricketts has been appointed by the trustees of the Rensselaer Polytechnic Institute, Director of that institution, vice Mr. D. M. Greene, resigned. Professor Ricketts was born in Elkton, Md., in 1856, and was graduated from Rensselaer in 1875, and was the same year appointed assistant in mathematics and astronomy. From 1882 to 1884 he served as assistant professor in these two branches and in 1884 he was appointed to the William Howard Hart professorship of rational and technical mechanics, which position he has ably filled ever since. During the summers of 1876-77 he acted as assistant engineer for the Troy & Boston Railway Co. Prof. Ricketts is the Engineer of the Public Improvements commission and Consulting Engineer of the Rome, Watertown & Ogdensburg Ry. He is also a member of Gov. Flower's staff, having been selected by the Governor as chief of the engineering corps. He is Vice-President of the Trojan Car Coupler Co., a Fellow of the American Association for the Advancement of Science and a member of the American Society of Civil Engineers.

SOCIETY PROCEEDINGS.

ASSOCIATION OF ENGINEERS OF VIRGINIA.—The first annual meeting was held at Roanoke, Va., Jan. 15, when the following officers were elected; President, Clarence Coleman; Vice-President, J. H. Yeatman; Secretary, J. R. Schick. Prof. J. H. Fitts read a paper on the first railway in Virginia, built in 1832 from Pittsburg to Weldon, 62 miles, by Mr. Moncure Robinson. Mr. Saabye read a paper on the highways of Virginia.

ENGINEERING ASSOCIATION OF THE SOUTH.—At the meeting at Nashville, Tenn., on Jan 15, the committee appointed at the last meeting to investigate and report to the association the feasibility of holding a "competitive trial of machinery used in highway building," reported that they had corresponded with the leading road-machine manufacturers of the country and that replies favorable to entering the contest had been received from all but one. The paper of the evening on "Engineering Features of the Cumberland Race Track" was then presented by W. G. Kirkpatrick. In comparing the "regulation track" with the "kite-shaped track" it was shown that the former has the advantage in seeing the race, while the latter has the advantage in speed for several reasons, one of which is that the distance usually passed around a regulation track is about 26 ft. longer than that around a kite-shaped track, a difference of about half a second of time. The merits of the Cumberland Park track were outlined, as well as the methods of construction. One peculiarity of this track is that it crosses Brown's Creek on steel bridges, which are so designed as to make the track as firm on the bridges as elsewhere This track has very light grades and is finished with an elastic dressing of turf.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS.—The 25th meeting will be held at San Francisco, Cal., the professional sessions beginning May 16 and lasting four days. The party will leave New York by a special train at 9:30 a. m., May 4, over the West Shore road; and the minimum time of absence will be 21 days. Papers to be presented should be in the hands of the Secretary not later than April 1, in order to secure their distribution in advance of the departure of the party.

MONTANA SOCIETY OF ENGINEERS.—At the annual meeting, Jan. 9, the following officers were elected: President, Col. Walter W. De Lacy, of Helena; 1st Vice-President, Albert B. Knight, of Butte; 2d Vice-President, J.S. Keerl, of Helena; Secretary and Librarian, F. D. Jones, of Helena; Treasurer, A. S. Hovey, of Helena. Trustee, Elliott H. Wilson, of Butte.

CONNECTICUT ASSOCIATION OF CIVIL ENGINEERS AND SURVEYORS.—At the annual meeting on June 12 officers were elected as follows: President, A. P Augur, of Middletown; Vice-Presidents, W. F. La Forge and W. G. Smith; Secretary and Treasurer, A. R. Wadsworth, of Farrington. Mr. Augur, in his address, reviewed the engineering work done in the state during the year; and a paper on "Sewage Disposal" was read by Mr. T. H. McKenzie.

ENGINEERS' CLUB OF PHILADELPHIA.—Annual meeting of Jan. 6.—President Wilfred Lewis in the chair; 69 persons present, including six visitors. The President read the annual address, in which he referred to the notable growth in the prosperity of the club during the year, and proceeded to review the progress and activity of the engineering profession during the same period. The Board of Directors reported a very marked increase in the attendance at the meetings. This increase has amounted to nearly 100% since the policy of issuing advance copies or abstracts of papers was adopted. Four numbers of the proceedings were issued during the year by the publication committee of the present board, and a fifth early in January. Important improvements have been made in the club house, including the introduction of a telephone. Forty-seven active and 3 associate members were admitted, and the resignations of 21 active and 3 associate members were presented and accepted during the year. The total number of members of all classes at the end of the year was 421. Over $300 have been subscribed to the fund for establishing an engineering headquarters and engineering congress at the World's Fair in Chicago in 1893. The amount is still in the treasurer's hands, the committee not deeming it advisable as yet to turn over any portion of it to the executive committee. The treasurer's report showed a marked improvement in the financial condition of the club during the year.

The tellers of election reported that the officers elected for the coming year are: President, James Christie; Vice-Presidents, Frederick H. Lewis, Pedro G. Salom; Secretary, John C. Trautwine, Jr.; Treasurer, T. Carpenter Smith; Directors, John E. Codman, George V. Cresson, Strickland L. Kneass, Wilfred Lewis, H. W. Spangler, and David Townsend.

After adjournment Mr. James Christie, President-elect, briefly addressed the members present and urged united efforts in behalf of the club during his coming administration. John C. Trautwine, Jr., Secretary.

ENGINEERS' CLUB OF ST. LOUIS.—At the meeting on Dec. 16, the following officers were elected: President, J. B. Johnson; Vice-President, B. L. Colby; Secretary, Arthur Thacher; Treasurer, C. W. Melcher; Librarian, R. E. McMath; Directors, George Burnet, B. H. Colby; for Board of Managers' Association of Engineering Societies, J. B. Johnson, J. A. Laird. The club has now 1 honorary, 131 resident and 41 non-resident members. The following papers have been promised for the current year:

"The Recent Survey of St. Louis, Its Methods and Results," B. H. Colby; "Pollution of Hudson River," Prof. C. C. Brown; "The Progress of Mapping in Missouri," Arthur Winslow; "Method and Results of Precise Leveling," O. W. Ferguson; "Elements Involved in Rapid Transit," B. F. Crow; "The Construction of Electric Railway Power Stations," B. J. Arnold; "Maximum Stress in Draw Bridges," Prof. M. A. Howe; "An Inclined Cable Railway for Transferring Freight Cars between the Upper and Lower Yards of the Western Cable Railway Company," Edward Flad; "Steam Generators with Hydro-Carbon Fuels," Dr. Wellington Adams; "Steam Shovels and Steam Shovel Work," E. A. Hermann; "Notes on the Harcuvar Pipe Line," Frank Nicholson; "Tunnel Timbering in Soft Ground," Fred W. Abbott.

NEW ENGLAND RAILROAD CLUB.—At the meetin on Jan. 13, Mr. J. L. Speirs, of the Rhode Island Locomotive Works, and Mr. F. W. Dean, read papers on "Locomotive Boilers." We reprint them in another column. Messrs. Chas. W. Sherburne, Chas. Richardson and Orlando Stewart were appointed to nominate officers for election at the March meeting. The subject for discussion at that meeting will be "Freight Car Trucks."

DENVER SOCIETY OF CIVIL ENGINEERS.—At the meeting on Jan. 12 the following officers were elected: President, John S. Titcomb; 1st Vice-President, R. A. Wilson; 2d Vice-President, Wm. Ashton; Executive Committee, Geo. G. Anderson, Prof. P. H. Van Diest and Thomas Withers; Secretary and Treasurer, Geo. H. Angell. The society has had a prosperous year.

CANADIAN SOCIETY OF CIVIL ENGINEERS.—The annual general meeting opened on 12th inst. at Montreal, Mr. John Kennedy in the chair. After the reading of the minutes of the last annual meeting, and the appointment of scrutineers of the ballot for the election of officers, Mr. T. C. Keefer moved the following resolution:

That the Canadian Society of Civil Engineers respectfully recommends to the government of Canada that no more locks be constructed upon the St. Lawrence canals with the length of chamber established by the Canal Commission in 1871, but that this length should be increased to meet the requirements of proportion of length to beam in modern specimens of naval architecture, as established, without reference to locks upon the upper lakes and upon the ocean.

[The present enlargement is being made with locks 45 × 270 ft., or 1 in 6.—Ed.]

In the evening a conversazione was held in the new Workman building, McGill College, and considerably over 700 guests were present. On the 13th the Gzowski Medal was awarded to Mr. D. H. Keeley for his paper on "Developments in Telegraphy." The resolution of Mr. Keefer, asking the Government to lengthen the locks in the construction of the St. Lawrence canals, was adopted without discussion.

Action on the circular of the International Engineers Congress of the World's Columbian Exposition was referred to the council, on the understanding that the meeting is of opinion it is inadvisable for this society to take part therein upon the basis proposed in the circular.

Prof. Bovey moved, seconded by Mr. Butler:

"That a committee be appointed consisting of Messrs. Hannaford, Kennedy, St. George, Peterson, Rusk, Ruttan, Boswell, Murphy, and the mover and seconder, to report upon the standard system of testing, and also the results of tests upon Canadian and foreign cements, at the next annual meeting."

The resolution was agreed to.

The contest for the presidency brought a very large vote. The scrutineers appointed to canvass the ballots for candidates for office reported that the total number of valid ballots was 212. Three ballots were thrown out as wholly bad, 12 were not counted for president, nor 41 for the council. The vote was as follows for president (there was no contest for the other offices): John Kennedy, 133 E. P. Hannaford, 67.

AMERICAN SOCIETY OF CIVIL ENGINEERS.—The annual meeting was held in New York, Jan. 20 and 21. The business meeting on Jan. 20 was held in a building nearly adjoining the Society House, and which was formerly used as a chapel. The president, Mr. Octave Chanute, occupied the chair, and there was a good attendance of representative members.

The first business was the reading of the report of the Committee on Uniform Standard Time by Mr. Sandford Fleming, Chairman of the Committee. The report stated that the work of the committee was drawing to a close, and reviewed the work done and the progress of the movement since the committee was first appointed in June, 1881, showing a very widespread progress, with uniformly successful and satisfactory results. During the past year there has been a very marked advance in Europe. The late Count von Moltke, in a speech to the German Reichstag in March, 1891, referred to the advantages of this system, stating that there were then in use in Germany five standards of time, besides those encountered at the frontiers, and he recommended the adoption of the 15th meridian east of Greenwich. Belgium is among the latest countries to adopt the system (Eng. News, Dec. 26, 1891). Austria adopted it in August, 1891, and Baden, Bavaria, and other German states will adopt it in May, 1892. The strange opposition hitherto manifested by France shows signs of weakening.

The report was accepted and the committee continued with thanks for its very valuable work. At a later stage of the proceedings Mr. Fleming said that he thought the time had come for some definite initiative step to be taken, and on motion of Mr. Egleston a resolution was adopted to the effect that such steps be taken as the committee may deem necessary to invite the railway companies of the United States, Canada and Mexico to adopt the new 24 hour notation on Oct. 12, 1892, the 400th anniversary of the discovery of America.

A progress report of the Committee on Domestic Water Supply was then presented by Mr. A. Fteley. The committee believes that the desired results as to the thorough investigation of water supplies, involving analyses of water, meteorological observations, etc., can only be attained by interesting other parties in the formation of a general association covering the entire country, so that observations may be made in all parts for record and comparison. Mr. Fteley stated that the idea of the committee is that the society can only agitate the question and bring the parties most interested into communication with one another. Steps are being taken in this direction, and it was suggested that water companies might be asked to appoint a committee of their own to investigate and report. The committee was continued.

The secretary announced the award of the Norman medal to Mr. John N. Freeman for his paper on "The Nozzle as an Accurate Water Meter," and the award of the Rowland prize to Mr. W. H. Burr for his paper on "The River Spans of the Cincinnati & Covington Bridge." The committee on the award of the Rowland prize also highly commended the paper by Mr. J. Foster Crowell on "The Oakley Arch."

The next business was the consideration of the place for the annual convention. The highest number of votes received was 26 for Chicago, the next being 20 for Boston, but as Chicago will in all probability be selected next year, it was not considered for the present year. After some discussion as to the merits of various places suggested a vote was taken of the sense of the meeting, which resulted in favor of Fort Monroe, Va., but the matter was referred to the Board of Direction for final decision. The

report of the Board of Direction was then read, and an abstract of this is given further on. Mr. Chanute read a letter inviting members who may be in Europe to attend the Fifth International Congress on Internal Navigation at Paris in July. A resolution was passed that the incoming president should answer the letter officially and that the Board of Direction should issue information and papers relating to the Congress. Three papers by American engineers are to be presented: "Towing," Mr. John Bogart; "Water and Rail Transportation for Commercial Purposes," Col. Merrill; "Improvement of River Mouths and Harbors," Mr. E. L. Corthell. The last meeting of the Congress was held in England in 1890 (Eng. News, Aug. 30, Sept. 6, 1890).

Some information was then presented in regard to the arrangements for an international engineering congress and to provide engineering headquarters in Chicago during the World's Columbian Exposition in 1893. There is to be a separate congress of engineering, forming one of a series of congresses now being arranged for by the World's Fair Auxiliary, which will provide rooms and bear the cost of printing, etc. For the anticipated expenses the reasonable share of the society has been put at $3,000, and circulars have been issued requesting subscriptions. So far only 88 subscriptions have been received, aggregating $816, and others are therefore requested in order that the proper arrangements may be carried out. There will be seven divisions of engineering, the arrangements for which have been assigned to the leading societies as follows: A, civil engineering, American Society of Civil Engineers; B, mechanical engineering, American Society of Mechanical Engineers; C, mining engineering and, D, metallurgical engineering, American Institute of Mining Engineers; E, electrical engineering, American Institution of Electrical Engineers; F, military engineering, officers of the U. S. Army; G, naval and marine engineering, officers of the U. S. Navy.

The report of the tellers appointed to canvas the ballot for officers was then read, as given further on, and after a few remarks by Mr. Mendes Cohen, the new President, a recess was taken for lunch.

The first business after the recess was the presentation of a brief progress report of the Committee on Units of Measurement by Mr. T. Egleston. The committee was continued. A preliminary progress report of the Committee on Uniform Methods of Tests of Materials Used in Metallic Structures was then read by Mr. Dagron, Secretary of the committee. Circulars have been issued to a number of engineers, iron and steel works, bridge works, etc., asking for answers to a series of questions relating to the tests of cast iron, wrought iron, steel and cast steel, and the results have been tabulated as far as possible, but in many cases the replies have been of a very divergent character. The committee is keeping in touch with foreign committees charged with similar investigations. The report was accepted, the committee continued, and the Board of Directors requested to set apart a date for the discussion of the report. Mr. Cartwright, in discussing the report, said he did not consider uniform methods of tests of much value, as the results depend so largely upon the manipulation and may therefore be very divergent. Mr. R. Moore suggested that tests should be made of the raw material and again of the finished shapes. The Committee on Rail Sections merely reported progress and was continued. The meeting then adjourned.

At the evening meeting Mr. Robert Moore gave a description of the elevated railway of the St. Louis Merchants' Bridge & Terminal Railway, at St. Louis, Mo. It is a double track, plate girder deck structure, connecting with the new Merchants' Bridge over the Mississippi (Eng. News, Dec. 21, 1889), and is built for a considerable portion of its length along the levee. The spans are from 28 to 90 ft. The posts are built of two latticed channels and reach to the level of the top of the girders. When two are in place they are spread apart to allow of the transverse plate girder being dropped between them, and the four longitudinal girders are then put in place. The girders are 6 ft. c. to c. on tangents, and as much as 8 ft. c. to c. on curves. The work was done by the Phœnix Iron Co., and 6 spans could be erected per day. The foundations were of concrete masonry with four anchor bolts to each post. These bolts were generally 7 ft. long, but sometimes 12 or 14 ft. The lower ends were threaded. In some cases the bolts had to be let into the solid rock ledge, and a packing of cement, like stiff grout, tamped in, was found the best in regard to holding power. The two outer girders are carried on brackets riveted to the posts, the other two being carried on brackets riveted to the transverse girders. The heaviest grade is 0.8%, compensated for curvature. The sharpest curve is about 14° and is spiraled. The structure is designed for two engines of 104 tons each, with 30,000 lbs. on each of four driving axles. The track is laid with 67-lb. rails on oak ties, 7 × 7 ins. on tangents, and 8 × 8 ins. or 9 × 9 ins. on curves, owing to the wide spacing of girders. The rail joints are square, and spliced with angle bars and four bolts. On curves the outside rails are elevated by yellow pine raising blocks under the ties. There are inside and outside white pine guard rails, bolted to every other tie, the inner and outer guards being bolted to alternate ties. The inner guard rails are 5 × 7 ins., are 7 ins. from the rail, and are faced with an angle iron 3 × 3 ins., fastened by countersunk screws to the guard rail and by vertical lag bolts to the ties. The outer guard rails are 6 × 8 ins., 13 ins. from the track rail. The ties are spaced 6 ins. apart in the clear. The rails are secured by spikes, but Bush interlocking bolts are used on the curves. After this Mr. G. H. Blakeley and Mr. T. E. Brown described the viaduct and the Otis hydraulic elevators for the North Hudson Co. Ry. at Weehawken, N. J. (Eng. News, Jan. 17, 1891). Both of these papers were illustrated by stereopticon views.

The following is the list of officers elected for the current year, and is unusually long, this being the first election under the new constitution:

President, Mendes Cohen, Baltimore, Md.

Vice-Presidents for two years, Samuel Whinery, Cincinnati, O.; Charles B. Brush, New York.

Vice-Presidents for one year, Samuel M. Gray, Providence, R. I.; John MacLeod, Louisville, Ky.

Directors for three years, Wm. P. Craighill, Baltimore, Md.; Desmond FitzGerald, Brookline, Mass.; Abraham Gottlieb, Chicago, Ill.; Benjamin M. Harrod, New Orleans, La.; Leffert L. Buck, New York; John Thomson, New York.

Directors for two years, Theodore N. Ely, Altoona, Pa.; Robert Moore, St. Louis, Mo.; P. Alex Peterson, Montreal, P. Q.; Robert L. Read, Cincinnati, O.; George W. McNulty, New York; O. F. Nichols, Brooklyn, N. Y.

Directors for one year, Estevan A. Fuertes, Ithaca, N. Y.; Albert B. Hill, New Haven, Conn.; Edmund T. D. Myers, Richmond, Va.; James D. Schuyler, San Diego, Cal.; Charles H. Myers, New York; John G. Van Horne, New York.

Secretary, Francis Collingwood, New York.

Treasurer, John Bogart, New York.

The report of the Board of Direction, above referred to, had been printed in advance and copies were distributed, which was a much better arrangement than the reading of the written reports as formerly. The financial statement was very much more detailed than the statements issued with any previous reports, and this is one of the satisfactory results of the new constitution. We give only a few notes from the report here, but we shall give a full abstract of it in a later issue.

Report of the Board of Direction.

On Jan. 1, 1892, the membership stood as follows:

	Res.	Non-Res.	Total.
Honorary members	4	1	5
Corresponding members	..	3	3
Members	190	918	1,108
Associate members	9	40	49
Associates	19	44	63
Juniors	59	162	221
Totals	281	1,167	1,449
Fellows, 54, of whom 5 members are included above, leaving			49
Subscribers to the building fund, 140, of whom 83 are entered in some one of the classes above, and 19 are deceased, leaving			38
Total connected with the society, Jan. 1, 1892			1,536
Total connected with the society, Jan. 1, 1891			1,455

The additions during the past year have been:

Honorary members	
Members	60
Associate members	49
Associates	10
Juniors	36
Fellows	1
Total additions	156

The losses during the year in each class have been:

Honorary members died	2
Members died, 12; resigned, 10; dropped for nonpayment of dues, 10	32
Associates died, 2; dropped for nonpayment of dues, 3; transferred to member, 3	8
Juniors died, 0; resigned, 2; dropped for nonpayment of dues, 4; transferred to member, 7; transferred to associate member, 17	303
Fellows died	
Totals: Deaths, 19; resignations, 12; dropped, 17; transfers, 24; total	75

There has been an addition of 155, and a loss of 75, making the actual net increase for the year, 81. On Jan. 1, 1891, there were 29 applications for membership pending; 213 applications have been received during the year; 52 candidates have been elected members, of whom 3 were transferred from associates, and 7 from juniors; 55 candidates have been elected as associate members, of whom 17 were transferred from juniors; 10 candidates have been elected associates; 36 candidates have been elected juniors; 1 candidate has been elected fellow. Applications now pending, 73, of which 30 are now before the society on the current ballot and blue lists.

The society has lost by death during the term covered by this report, 2 honorary members—Moncure Robinson and Sir John Hawkshaw; 12 members—Addison Connor, Charles E. Fogg, John M. Goodwin, Julius E. Hilgard, Arthur Macy, Col. William E. Merrill, Samuel H. Miller, J. Albert Monroe, Richard Potts, Samuel B. Reed, James R. Wardlaw and Arthur Owen Wilson; 2 associates—John Lockwood and Edward Wheaton; 3 fellows—A. P. Cochran, John Lawler and William L. Scott.

During the year beginning Dec. 1, 1890, 20 meetings of the society have been held, at which 57 papers have been read, which have been discussed either orally or in writing by 235 persons. These have been printed in 12 monthly numbers, covering 1,227 pages, illustrated by 219 cuts and 178 plates. The proceedings, containing minutes of meetings, notices, annual list of members, etc., have covered 376 pages. There have also been issued an index to vols. i. to xxi. of the Transactions (inclusive), covering 272 pages, and the annual catalogue, with the constitution, etc., of 134 pages.

The Library Committee applied to the Board of Direction for the sum which would probably be saved on the postage account, for the increased maintenance of the library, and $850 have been appropriated. In addition to this Messrs. Chanute, Wallace and Breithaupt, who were awarded the Rowland prize for their paper on the Sibley Bridge, elected to return the amount of the prize into the library fund, and a set of the Century Dictionary was purchased with the money so given and a small additional sum. The expenditures from this appropriation have been for the Century Dictionary, a set of the Encyclopædia Britannica, and completing files of current technical papers and binding them, and unbound transactions of engineering and technical societies; also in binding such books as were in danger of damage. There are now about 15,000 volumes and pamphlets in the library.

Report of the Treasurer.

Receipts:

Balance on hand Dec. 31, 1890		$2,565.36
Entrance fees	$3,125.00	
Current dues	17,217.50	
Past dues	3,179.42	
Dues for year beginning Jan. 1, 1892	4,533.45	
Sales of publications	1,374.07	
Certificates of membership	140.25	
Advertisements	1,396.00	
Interest	1,045.57	
Compounding dues	575.00	
Fellowship fees	250.00	
Other sources	50.75	
		32,887 01
Total		$35,452.37

Disbursements.

Interest on mortgage	$800.00	
Taxes	434.00	
Publications	12,830.17	
Stationery and printing	1,272.42	
Postage	1,484.18	
Library	2,041.94	
Salary of Secretary	2,000.00	
Convention and annual meeting	1,575.63	
Janitor	660.00	
House supplies and furniture	447.86	
Fuel	249.50	
Water	18.00	
Gas	167.59	
Certificates of membership	74.75	
Insurance	49.40	
Norman medal and Rowland prize	121.55	
Treasurer's books, accounts, collections	1,200.00	
Work of committees	293 80	
Repairs and betterments, society house	537.92	
Other expenditures	507.98	
Current business	2,114.80	
		$29,791.79
Balance in hands of Secretary for current expenditures	$1,000.00	
In bank and trust company and hands of Treasurer	4,660.58	
		5,660.58
		$35,452.37

COMING TECHNICAL MEETINGS.

CENTRAL RAILWAY CLUB OF BUFFALO.
Jan. 27. Secy., Jas. Macbeth.

ILLINOIS SOCIETY OF ENGINEERS AND SURVEYORS.
Jan. 27 to 29. Grand Pacific Hotel, Chicago. Secy., S. A. Bullard, Springfield.

CIVIL ENGINEERS' SOCIETY OF ST. PAUL.
Feb. 1. Secy., C. L. Annan.

ENGINEERS' CLUB OF KANSAS CITY.
Feb. 1. Baird Building. Secy., H. Goldmark.

WESTERN SOCIETY OF ENGINEERS.
Feb. 3. Secy., J. W. Weston, 240 La Salle St., Chicago.

ENGINEERS' CLUB OF ST. LOUIS.
Feb. 3. Secy., Arthur Thatcher, Odd Fellows' Building.

AMERICAN SOCIETY OF CIVIL ENGINEERS.
Feb. 3. Secy., F. Collingwood, 127 East 23d St., New York.

ENGINEERS' CLUB OF MINNEAPOLIS.
Feb. 4. Public Library Bldg. Secy., F. W. Cappelen.

ASSOCIATION OF CIVIL ENGINEERS OF DALLAS.
Feb. 5. Secy., E. K. Smoot, 803 Commerce St.

CIVIL ENGINEERS' CLUB OF CLEVELAND.
Feb. 5. Secy., A. H. Porter, 50 Euclid Ave.

TECHNICAL SOCIETY OF THE PACIFIC COAST.
Feb. 5. Secy., O. van Geldern, 819 Market St., San Francisco.

SWEDISH ENGINEERS' CLUB.
Feb. 6. Secy., F. Valentine. At 231 Union St., Brooklyn, and 646 North 10th St., Philadelphia.

ENGINEERS' CLUB OF PHILADELPHIA.
Feb. 6. 1122 Girard St. Secy., J. C. Trautwine.

NORTHWEST RAILROAD CLUB.
Feb. 6. Union Station, St. Paul.

ATLANTA SOCIETY OF CIVIL ENGINEERS.
Feb. 9. Secy., Parker N. Black, Capitol Block.

NORTHWESTERN SOCIETY OF ENGINEERS.
Feb. 9. Occidental Block, Seattle. Secy., E. H. Warner.

NEW ENGLAND RAILROAD CLUB.
Feb. 10. United States Hotel, Boston. Secy., F. M. Curtis. "Locomotive Boilers and Their Attachments."

ENGINEERING ASSOCIATION OF THE SOUTHWEST.
Feb. 11. Secy., O. H. Landreth, Nashville, Tenn.

TECHNICAL SOCIETY OF NEW YORK.
Feb. 11. 194 Third Ave. "Boiler Plant."

DENVER SOCIETY OF CIVIL ENGINEERS.
Feb. 11. Secy., Geo. H. Angell, Jacobson Block.

WESTERN RAILWAY CLUB.
Feb. 16. Rookery Building, Chicago. Secy., W. H. Marshall.

ENGINEERS' SOCIETY OF WESTERN PENNSYLVANIA.
Feb. 16. Secy., J. H. Harlow, Pittsburg, Pa.

BOSTON SOCIETY OF CIVIL ENGINEERS.
Feb. 17. Secy., S. E. Tinkham, City Hall.

CANADIAN SOCIETY OF CIVIL ENGINEERS.
Feb. 18. Secy., C. H. McLeod, Montreal, P. Q.

ENGINEERS' CLUB OF CINCINNATI.
Feb. 18. Secy., J. F. Wilson.

SCANDINAVIAN ENGINEERING SOCIETY OF CHICAGO.
Feb. 18. Secy., T. G. Pihlfeldt, 118 Adams St.

SOUTHERN AND SOUTHWESTERN RAILWAY CLUB.
Feb. 18. At Atlanta, Ga. Secy., F. A. Charlot, Macon, Ga.

NEW YORK RAILROAD CLUB.
Feb. 18.

NORTHWESTERN TRACK AND BRIDGE ASSOCIATION.
Feb. 19. Union Station, St. Paul.

MONTANA SOCIETY OF CIVIL ENGINEERS.
Feb. 20. Secy., F. D. Jones, Helena.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS.
May 16 to 20. San Francisco, Cal. Secy., F. R. Hutton, 12 W. 31st St., New York.

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AND

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D. McN. STAUFFER, A. M. WELLINGTON.....EDITORS
CHAS. W. BAKER, E. E. R. TRATMAN, M. N. BAKER, F. P. BURT, } ASSOCIATE EDITORS
GEO. H. FROST.....BUSINESS MANAGER

SUBSCRIPTION RATES: one year, $5.00; 6 months $2.50; 4 months, $2.00; single copies, 15 cents. To all foreign countries in the Postal Union, add $2.08 to above prices for postage. Subscribers can have the mailing address of their paper changed as often as they desire. Send both the old and the new addresses. No club rates allowed.

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ADVERTISING RATES, 20 cents per line agate measure. Schedule sent on request. Changes of advertisements must be in hand on Tuesday afternoon; new advertisements, Wednesday afternoon; transient advertisements, not later than Thursday noon. The last pages go to press early on Friday, and we shall be obliged if subscribers who fail to receive their papers promptly will notify us without delay.

"The Morning Call," San Francisco, Jan. 12, under the head of "Engineering Notes," reprints nearly a column of items gleaned verbatim from the two preceding issues of Engineering News. We approve of the good judgment of our contemporary; but can not help hinting that it would have been more courteous had the source of information been acknowledged. As a business "tip" we would remind the "Call" that Engineering News has many readers on the Pacific Slope.

The readers of this journal, though few of them are themselves politicians, have in one way or another a good deal of influence upon politicians and political matters, if they choose to exercise it, especially on questions affecting the management of public works. We feel justified, therefore, in asking every one of them to read and remember the facts in Mr. Moore's admirable paper on Municipal Engineering in St. Louis, which is published in another column. It is not long and it is not dull. It will be found a refreshing kind of reading, as showing that some things are well managed and well done, even in our city administration, which is the worst blot on our political methods. It is only a question of time when the public works of all our cities will be managed in the same sensible and effective way that is followed in St. Louis; and every engineer, and every public-spirited man, should do what he can to hasten the coming of that happy day, by at least knowing and spreading the knowledge of what has been actually achieved in St. Louis. The scurvy politicians of that city have not ceased to "kick" at the pure and non-political management of its public works; and occasionally they have scored some slight success, as in a recent incident which we might mention but will not. But as a whole, the system is so deeply seated in the confidence and respect of the public, regardless of party, that it will not easily be upset, but rather grow stronger with age.

The nature of the error made by a contemporary which undertook to declare that the Providence & Worcester R. R. had no block system, "but only a system of station protection," will be apparent from a map and note which appears in another column, accompanying a letter from the Chief Engineer of the road. It was evidently supposed that because the electric current was not carried through all the rails of the track, but only through about half of it, leaving the remaining half, *i. e.*, certain parts between stations, without any current through the rails themselves, therefore the block signal system itself could not be complete and continuous. Such a notion could only arise from a very imperfect knowledge of the system, however. So far is it from being true, that it is only necessary to have the current passing through a single pair of rails at the beginning and end of each of the alleged "station protection" sections (those shown in black on map on another page) to have a complete and perfect automatic block signal system. The fact that, in addition to this, the electric current is actually carried through nearly half the entire length of the track adds nothing to the perfection of the block system. It merely adds to it a further protection against open switches, trains broken in two, etc., which is usually obtainable only by interlocking plant; and protection against broken rails and hand cars or other obstructions on the track which is not otherwise obtainable at all. It was naturally and wisely concluded that there was no use of protecting against open switches on sections where there were no switches, and that the automatic protection against broken rails or hand cars was not so important but that it could be dispensed with on short sections between stations.

We hold it to be entirely pardonable for any man or journal to fall into error; but it is not so pardonable that it should declare the truthful statements of another to be false without taking some slight precautions to make sure that they are false, as, for instance, by making prior inquiry of some officer of the road. Especially is this true when the error is of a nature to block the progress of a needed reform, as it emphatically was in this case. We shall, therefore, look with confidence to see a retraction of this error, and a statement of the real facts, in an early issue of our contemporary.

We devote a considerable portion of our space in this issue, as in our last, to an abstract of the exceptionally valuable report of the Statistician of the Interstate Commerce Commission. In later issues we shall take occasion to review more at leisure, and with more available space, some of the many important and interesting facts which can be deduced from these records. They are a vast advance upon last year's report, which was itself a great advance upon anything which had ever existed before. For the first time we now have national railway statistics worthy of the name, and it is no small satisfaction to observe that they are in some important respects in advance of those published by any other country. The most important of all advances in this report is the subdivision of the United States into groups, so that comparative tendencies in various sections of the country can be easily studied. Such a subdivision we have often urgently recommended, and we are gratified to believe that we were in some degree instrumental in causing this step to be taken, despite the great addition to the labors of the statistical bureau which such subdivision involved. The preparation of these statistics is in able and faithful hands. It is to be regretted, as we said last week, that there is not a closer correspondence between the three diverse systems of subdividing the United States which now exist; but having growled our little growl over this unfortunate fact, it is but just to say on the other hand that after a series of years have made comparisons with past years possible, there will be certain advantages in the minuter subdivision which the Interstate Commerce Commission has seen fit to adopt, and that the report otherwise leaves little to complain of.

RAILWAY CONSTRUCTION IN 1891.

The final detailed statistics of new railway track laid in the United States during the calendar year of 1891, which we present with this issue, show that the addition to the railway mileage of the country during the year will not vary much from the totals given in our advance summaries published three weeks ago. The figures given show that 4,053 miles of railway track have been laid in 40 states and 3 territories, bringing the total mileage of the United States up to 171,044 miles. These figures we believe to be substantially correct, and to cover the field as thoroughly as possible at the present date, at the same time premising that upon the final corrected returns there will doubtless be some changes in our totals.

In connection with these statistics, we show in the accompanying map the location of the several lines of track laid during the year, together with the location of all track laid during the preceding five years. The tracklaying for the three years of 1886-88, inclusive, has been combined and is shown on our map by one color in order to prevent the confusion of colors resulting from the use of a different color for each year, but that of each of the other three years is shown separately. The map thus covers a period of six years, during which time there have been constructed 42,687 miles of railway, or 33.2 per cent. of the total mileage of the country. Placing the cost of the construction and equipment of this new road at the low figure of $30,000 per mile, these figures represent the cash investment of over $1,280,000,000 in new railway in six years, and an addition directly and indirectly of at least from six to eight times this amount to the nation's wealth.

The following table gives in a condensed form the matter graphically shown by our map:

Table Showing by Groups of States Mileage of New Railway Constructed in Six Years, with Increase from End of 1885.

	Mileage at end of 1885.	Track laid, 1886-88 inclusive.	Track laid during 1889.	1890.	1891.	Increase in 5 years. Ttal.	P. C.
New England..	5,311	346	80	97	51	574	9.09
Middle.....	18,475	762	437	392	529	2,121	11.4
No. Central ...	31,502	3,967	687	619	479	5,752	18.3
So. Atlantic.....	12,167	2 924	1,095	1,199	1,002	6,220	51 1
So. Central.....	9 650	2,199	772	846	505	4,323	44.7
Southwestern ..	22,095	9,090	851	901	407	11,249	50 9
Northwestern ..	19,348	6,421	566	981	562	8,530	44.
Pacific.....	8,790	2,176	604	622	516	3,918	44.5
	128,357	27,885	5,092	5,657	4,053	42,687	33.2

It will be seen from the table that the bulk of new construction has been in the South. The 18 states comprised in the South Atlantic, South Central and Southwestern groups have laid 21,796 miles, or 51 per cent. of the total amount of track laid in the United States during the six years covered by the figures given—a remarkable and striking evidence of the rapid development of this section of the country. The South Atlantic States show the largest per cent. increase, 51.1 per cent., but are closely followed by the Southwestern with 50.9 per cent. The percentage of increase for the Pacific, Northwestern and South Central groups run very evenly, each having added a little over 44 per cent. to its mileage. For the other groups the increase has been less, as is but natural, considering their advanced industrial development as compared with the remainder of the country. The total increase for the United States is, as before stated, 33.2 per cent.

Turning to the work of the present year, we give in the following table the mileage of new track laid by states and groups of states:

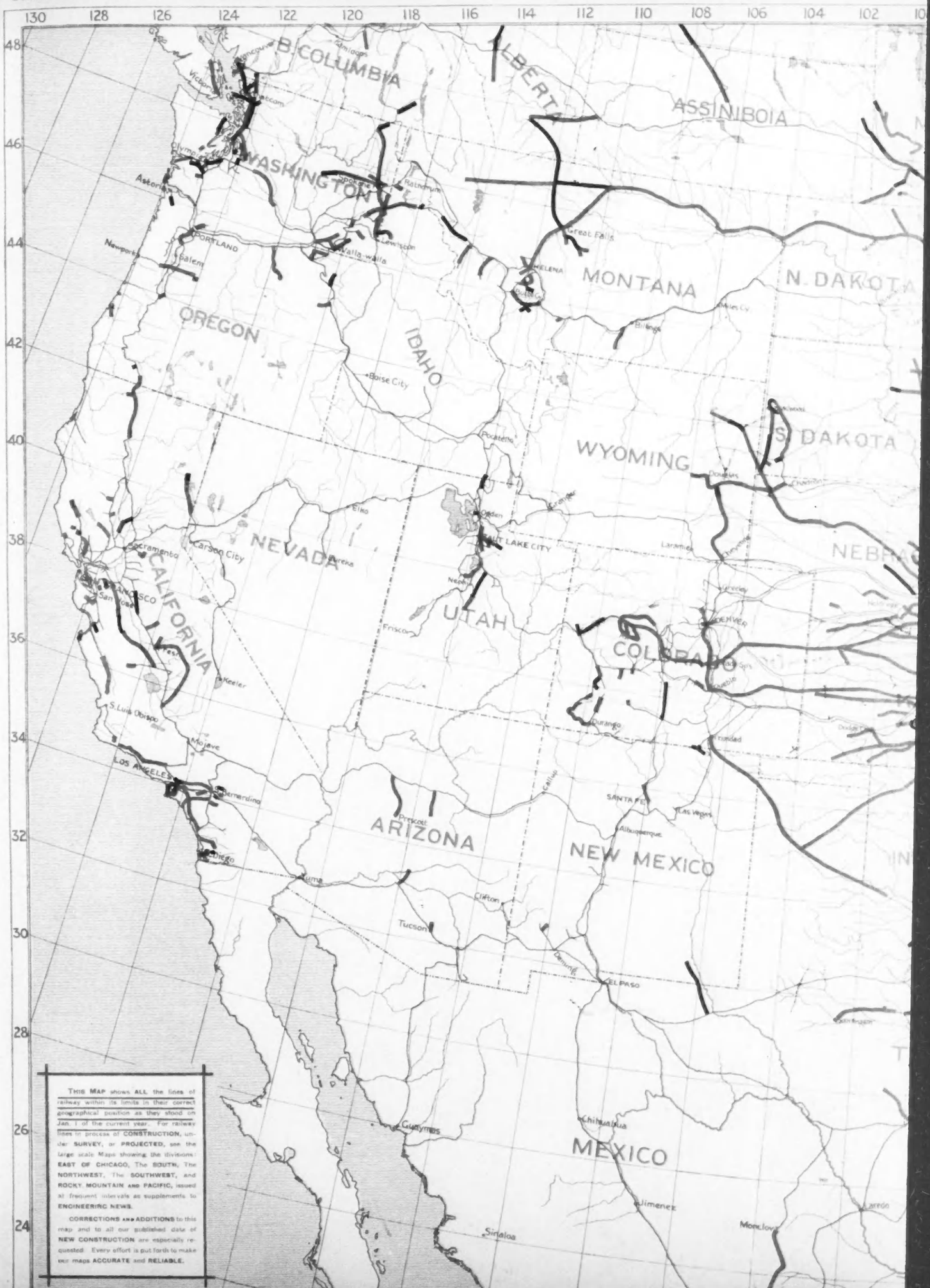
Table Showing Mileage of New Railway Built in 1891, by States and Groups of States.

	No. Cos.	No. lines.	Miles.
New England States.			
Me.....	2	2	9
N. H.....	2	3	10
Vt.....	2	2	20
Mass.....	2	2	8
R. I.....	1	1	4
Total.....	9	10	51
Middle States.			
N. Y.....	4	6	173
N. J.....	7	11	53
Pa.....	21	37	300
Md.....	1	1	3
Total.....	29	55	529
North Central States.			
Ohio.....	12	16	156
Mich.....	6	8	98
Ind.....	4	4	19
Ill.....	7	7	79
Wis.....	5	5	136
Total.....	32	40	479
South Atlantic States.			
Va.....	6	10	191
W. Va.....	7	10	172
N. C.....	6	8	106
S. C.....	8	8	220
Ga.....	11	11	231
Fla.....	6	6	82
Total.....	43	53	1,002

	No. Cos.	No. lines.	Miles.
South Central States.			
Ky.....	4	4	46
Tenn.....	11	12	145
Ala.....	7	7	162
La.....	5	6	153
Total.....	25	29	506
Southwestern States.			
Nev.....	3	3	30
Ark.....	6	6	82
Ind. Ter.....	1	1	6
Tex.....	7	8	125
Kan.....	1	1	1
Colo.....	3	5	145
N. Mex.....	1	1	18
Total.....	22	25	407
Northwestern States.			
Ia.....	3	3	31
Minn.....	4	7	108
Neb.....	2	2	44
N. Dak.....	2	3	161
S. Dak.....	2	3	43
Wyo.....	1	1	48
Mont.....	2	4	188
Total.....	11	23	552
Pacific States.			
Wash.....	6	13	221
Idaho.....	1	1	20
Ore.....	3	3	48
Cal.....	7	9	146
Utah.....	3	4	81
Total.....	15	29	516

Grand total for the United States, 4,053 miles of track laid on 265 lines by 187 companies.

As will be seen by our detailed list, the work of the year has been mostly on short branch and connecting lines, with a few important exceptions, and has been carried on by 187 companies on 265 lines, making the average length of the lines constructed 10.1 miles. This is especially noticeable in the section of country best supplied with railway facilities, viz., the New England, Middle and North Central States, the average length of line for these



THIS MAP shows ALL the lines of railway within its limits in their correct geographical position as they stood on Jan. 1 of the current year. For railway lines in process of CONSTRUCTION, under SURVEY, or PROJECTED, see the large scale Maps showing the divisions: EAST OF CHICAGO, The SOUTH, The NORTHWEST, The SOUTHWEST, and ROCKY MOUNTAIN AND PACIFIC, issued at frequent intervals as supplements to ENGINEERING NEWS.

CORRECTIONS AND ADDITIONS to this map and to all our published data of NEW CONSTRUCTION are especially requested. Every effort is put forth to make our maps ACCURATE and RELIABLE.

106
104
102
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MANITOBA
WINNIPEG
N. DAKOTA
S. DAKOTA
NEBRASKA
MINNESOTA
WISCONSIN
MICHIGAN
ILLINOIS
INDIANA
OHIO
MISSOURI
KENTUCKY
TENNESSEE
INDIAN TER.
ARKANSAS
LITTLE ROCK
MISSISSIPPI
ALABAMA
GEORGIA
FLORIDA
LA.
TEXAS
Austin
Waco
Dallas
Fort Worth
Houston
San Antonio
Galveston
Laredo
Brownsville
Mobile
NEW ORLEANS
Natchez
Vicksburg
Meridian
Memphis
Nashville
Bowling Green
Louisville
Cincinnati
Toledo
Chicago
Milwaukee
Green Bay
Duluth
Minneapolis
St. Paul
Fargo
Grand Forks
Jamestown
Bismarck
Aberdeen
Watertown
Huron
Pierre
Mitchell
Sioux Falls
Yankton
Norfolk
Omaha
Lincoln
Hastings
Grand Island
Kearney
Holdrege
North Platte
Sterling
Denver
Colorado Springs
Pueblo
Trinidad
Amarillo
Wichita Falls
Abilene
San Angelo
Waco
Tyler
Texarkana
Shreveport
Monroe
Alexandria
Natchez
Vicksburg
Jackson
Meridian
Tuscaloosa
Montgomery
Pensacola
Mobile
Biloxi
New Orleans
Baton Rouge
Lake Charles
Beaumont
Port Arthur
Galveston
Houston
Corpus Christi
Laredo
Brownsville
Harlingen
Victoria
Austin
San Antonio
Del Rio
El Paso
Albuquerque
Santa Fe
Las Vegas
Raton
Trinidad
Pueblo
Colorado Springs
Denver
Cheyenne
Laramie
Rawlins
Rock Springs
Green River
Evanston
Ogden
Salt Lake City
Provo
Price
Moab
Grand Junction
Montrose
Durango
Farmington
Gallup
Flagstaff
Winslow
Holbrook
Show Low
Globe
Tucson
Nogales
Douglas
Bisbee
Deming
Las Cruces
Roswell
Carlsbad
Artesia
Hobbs
Lubbock
Plainview
Amarillo
Dalhart
Guymon
Liberal
Garden City
Dodge City
Hutchinson
Salina
Manhattan
Topeka
Kansas City
St. Joseph
Atchison
Leavenworth
Lawrence
Ottawa
Olathe
Emporia
Chanute
Parsons
Coffeyville
Independence
Joplin
Springfield
Cape Girardeau
Poplar Bluff
Sikeston
New Madrid
Caruthersville
Blytheville
Jonesboro
Paragould
Pocahontas
Walnut Ridge
Batesville
Searcy
Conway
Little Rock
Pine Bluff
Arkadelphia
Hot Springs
Texarkana
Fort Smith
Muskogee
Tulsa
Okmulgee
McAlester
Ardmore
Durant
Hugo
Paris
Sherman
Denison
Gainesville
Wichita Falls
Vernon
Childress
Quanah
Paducah
Clarendon
Memphis
Jackson
Tupelo
Corinth
Iuka
Florence
Sheffield
Decatur
Huntsville
Gadsden
Anniston
Birmingham
Tuscaloosa
Selma
Montgomery
Dothan
Eufaula
Columbus
Macon
Albany
Valdosta
Thomasville
Tallahassee
Quincy
Marianna
Panama City
Pensacola
Mobile
Biloxi
Gulfport
Hattiesburg
Laurel
Meridian
Columbus
Starkville
Greenville
Clarksdale
Cleveland
Greenwood
Yazoo City
Vicksburg
Natchez
Brookhaven
McComb
Hammond
Baton Rouge
New Orleans
Houma
Thibodaux
Morgan City
Lafayette
Opelousas
Crowley
Lake Charles
Jennings
Abbeville
New Iberia
Franklin
Houma
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0
100
200
300
400
150 MILES TO 1 INCH

ENGINEERING NEWS SERIES OF MAPS: No. 40.

UNITED STATES.

THE RAILWAY CONSTRUCTION OF SIX CONSECUTIVE YEARS.

TRACK LAID IN THREE YEARS, 1886-87-88	27,885 MILES
TRACK LAID IN 1888	5,092 MILES
TRACK LAID IN 1890	5,657 MILES
TRACK LAID IN 1891	4,075 MILES

The above includes only main track, laid during each calendar year, on which regular trains are, or are to be run, to do business as common carriers of both freight and passenger traffic; thus excluding sidings, double tracking, lumber or mining roads not carrying passengers and motor roads carrying passengers but no freight.

three groups being 5.1 miles, 9.5 miles and 12.1 miles, respectively. The Northwestern States have the longest average length of line, viz., 24.5 miles and the South Atlantic States have the next longest, 18.9 miles.

For this as for previous years the greatest activity has been in the three southern groups, over 47.2 per cent. of the total work done having been in these 17 states. The other five groups, with the exception of the Middle States, which show a notable increase in activity, has each built about its usual percentage of the total.

The State of Georgia, which for the years 1889 and 1890 heads the list in the amount of new railway built, falls to second place in 1891, the State of Pennsylvania having laid 69 miles more track during the year. Among the other states which have a large mileage of new work to their credit are Washington, 221 miles; North Carolina, 220 miles; Virginia, 191 miles, and Montana, New York and West Virginia, with 188 miles, 173 miles and 172 miles respectively. No track was laid in the states of Delaware, Connecticut and Mississippi, or the territory of Arizona. The State of Kansas, which laid 1,526 miles in 1886, 2,102 miles in 1887, and 508 miles in 1888, laid only 1.39 miles in 1891. Among the other states which have laid small amounts are Maryland, 3 miles, and Rhode Island, 4 miles.

While the work of the year has been confined largely to the building of short branches and connections, there have been a number of unusually important lines completed. Probably the most important of these are the extension of the Lehigh Valley Ry. to Buffalo, N. Y., a distance of 101 miles, and the Trenton Cut-off of the Pennsylvania R. R., 45 miles. Both will be double track lines when completed, but as yet only a single track has been laid. The first mentioned line will give the Lehigh Valley Ry., which now leases trackage rights over the New York, Lake Erie & Western R. R. into Buffalo, an independent line into that important lake port, and in connection with the proposed extension into Philadelphia, which is very likely to be built within the next few years, will give the company a strong competing line for through traffic from the West to the seaboard. The Trenton Cut-off of the Pennsylvania R. R. was built, in accordance with the policy of that company, to provide, as far as possible, separate lines for through and local traffic, to furnish an independent line for the through traffic to New York and other northeastern cities, and thus save the loss of time occasioned by the necessary switching delays in Philadelphia. Among the other notable lines are the completion of the South Bound R. R. between Savannah, Ga., and Columbia, S. C., 127 miles of which were built this year; the extension of the Seaboard Air Line system toward Atlanta, Ga., 95 miles, and the completion of 162 miles of the Pacific extension of the Great Northern system, this last being the longest line constructed during the year.

Considering the country as a whole it is seen that work has been far less active than for several years heretofore. As stated, however, in connection with our summaries published three weeks ago, it has probably been fully as active as the best interests of the country will warrant. The prospects for the future as nearly as we can judge we noted at that time. We shall consider the matter at length in connection with our forthcoming map showing the prospective railway construction for 1892.

In addition to our statistics of new railway construction in the United States we have also collected figures of the progress of work in the Dominion of Canada. While, owing to the difficulty in obtaining complete returns from some of the companies, we claim no such correctness for these figures as for those covering the United States, we think they are substantially accurate. According to the figures the work of new construction is distributed as follows:

Province.	No. cos.	No. lines.	Miles.
Quebec	4	4	68
Ontario	5	6	89
Manitoba	2	2	38
Northwest Territory	2	2	152
British Columbia	1	3	65
New Brunswick	1	1	12
Nova Scotia	3	3	34
Total	14	21	478

On June 30, 1890, according to the Government reports, there were 13,356 miles of railway in Canada. Estimating the mileage complete in the last six months of 1890 and adding this, together with the 438 miles built this year, to this total, the present railway mileage is approximately 14,100 miles.

OWNERSHIP OF AMERICAN WATER-WORKS.

Those who attended the earlier meetings of the American or New England Water-Works Associations will remember that a favorite subject for discussion was the relative advantages of public and private ownership of water-works. In later years the subject has not been so much discussed by these bodies, possibly because it has been seen that neither side has been making converts, actual connection with public or private works being more forcible than arguments.

Only a few years ago even the total number of water-works was not known, and the ownership still less completely. In collecting information for the "Manual of American Water Works" for 1891, a special effort, which proved successful, was made to close the comparatively few gaps still remaining in the list of ownerships. In addition great care was taken to ascertain how, in the case of privates, work the interests of the public had been guarded in the granting of franchises.

The final results of the above investigations are summarized and commented upon below, but with the idea of presenting facts rather than of pleading for either private or public works. It is believed that the facts given have an important bearing on the whole question of natural monopolies, of course from the historical side.

The present ownership is shown in detail for both the United States and Canada in Table 9—S, where the number of public, private and all works, together with the percentages of public and private, is given for each state and group of states.

By percentages the number of public and private works in each group is as follows, the South Central group leading in private and the North Central in public works:

Group.	Private.	Public.
South Central	85.7	14.3
Pacific	81.4	18.6
Middle	66.8	33.2
Southwestern	66.1	33.9
South Atlantic	60.4	39.6
New England	54	46
Northwestern	41	59
North Central	36.4	63.6

By states the percentages of private and public works are as follows:

State.	Private.	Public.	State.	Private.	Public.
Montana	100	0	Texas	66.6	33.4
Nevada	100	0	Rhode Is'd.	64.3	35.7
Alabama	95	5	New Jersey	62	38
Maine	94.6	5.4	Kansas	58.9	41.1
Arkansas	91.7	8.3	New York	58.8	41.2
California	90	10	Oregon	57.7	42.3
Idaho	90	10	Utah	57.1	42.9
Missouri	88.9	11.1	Virginia	51.2	48 8
New Mexico	88.9	11.1	West Va.	50	50
Tennessee	87.5	12.5	Georgia	47.6	52.4
S. Carolina	85.7	14.3	Indiana	46	54
Mississippi	85.7	14.3	Colorado	42.1	57.9
Florida	83.4	16 6	Minnesota	38.2	61.8
N. Carolina	80	20	Massach'ts.	35.5	64.5
Kentucky	78.3	21.7	Iowa	33.8	62.2
Maryland	77.8	22.2	Ohio	32.6	67.4
Pennsylv'a	76.2	23.8	Illinois	32.3	67.7
Louisiana	75	25	Vermont	29.6	70.4
Arizona	75	25	North Dak	28.6	71.4
Washington	73.7	26.3	Michigan	24.8	75.2
Connecticut	70.8	29.2	South Dak	22.7	77.3
New Hamp.	69.4	30.6	Nebraska	22.6	77.4
Wisconsin	68	32	Delaware	17	83
Wyoming	66.7	33.3	Dist. Col.	0	100

In general it may be said that those sections of the country that are new, or slow in their development, or have been greatly retarded at any time, have the largest percentage of private works, as note Montana and Nevada at head of the list with no public works, and all the Southern States but Georgia with 50 per cent. or more of private works, while in some the percentage is quite high. Maine, Arkansas, Missouri and California might not be considered as new states. But Maine is peculiarly favorable to corporations. Arkansas does not allow cities to incur a bonded indebtedness. Corporations obtained immense power in California while the state was new. Missouri is backward, at least in developing cities. Maryland may with fairness be classed with the Southern States. Pennsylvania has many low-cost works in small places where companies have taken the initiative, and in late years a few capitalists have secured charters covering several adjacent towns with a promise of future growth.

It is interesting to note in passing that Virginia, with 51.2 per cent. of private works, has four of the nine public gas plants in the United States and that West Virginia, with public and private works half and half, has one public gas plant. The other public gas plants are two in Ohio, one each in Kentucky and Pennsylvania, the latter at Philadelphia.

While in numbers the private plants are ahead, the showing is sharply reversed when populations are considered, 66.2 per cent., or 15,018,552 out of a total of 22,678,354, being supplied by public works. These figures include estimated populations for about 150 small places. The distribution of population on public and private works and the percentage of each to the total in the several groups is as follows:

Group.	Public.	Private.	Total.	Per cent. Public.	Per cent. Private.
New England	2,205,357	1,050,936	3,256,293	67.7	32.3
Middle	6,547,342	1,754,982	8,302,324	78.8	21.2
South Atlantic	487,534	391,414	878,948	55.5	44.5
South Central	183,625	856,651	1,040,276	17.7	82.3
North Central	3,896,632	1,038,556	4,935,188	78	22
Northwestern	772,926	880,053	1,652,979	46.8	53.2
Southwestern	673,019	837,956	1,510,975	44.5	54.5
Pacific	252,117	789,154	1,041,271	24.2	75.8
United States	15,018,552	7,659,802	22,678,354	66.2	33.8
Canada	866,460	197,003	1,063,463	81.5	18.5

The several groups rank as follows in percentage of public and private works:

Group.	Percentage of Public.	Percentage of Private.	Group.	Percentage of Public.	Percentage of Private.
Middle	78.8	21.2	Northwestern	46.8	53.2
North Central	78	22	Southwestern	44.5	54.5
New England	67.7	32.3	Pacific	24.2	75.5
South Atlantic	55.5	44.5	South Central	17.7	82.3

The relative number of public and private works and of populations on each, by groups of states, is shown graphically by the diagrams Figs. 1 to 8. Fig. 1 shows the 1890 population, and Fig. 2 the number of public and private works. Figs. 3 and 4 show the percentages corresponding to the above. In Figs. 5 to 8 populations, number of works and the corresponding percentages, are massed in four great sections of the country, including: (1) New England and Middle States; (2) North Central and Northwestern; (3) South Atlantic, South Central and Southwestern, and (4) the Pacific States.

The largest cities of the country have generally deemed it best to own their water-works, sooner or later, the exact present status in this respect being given below and and also discussed more fully further on in connection with changes in ownership. Of the 10 largest cities in the United States all but San Francisco and New Orleans now own their works. New Orleans bought the private works there in 1868 and sold them again in 1878, the sale probably being caused by financial depression. The works at San Francisco have cost too much and the company has too secure control over available water supplies to permit of the duplication of works by the city, while perhaps purchase of the existing plant is equally out of the question.

Table 10-S shows for this country by states and groups of states, the number of works in towns of the size named at its head. In towns with over 100,000 inhabitants there are 21 public against 11 private works. From 50,000 to 100,000, the relation is nearly the same, 22 to 13. In the next class, from 20,000 to 50,000, the public works are nearly overtaken by the private, there being 56 of the former to 54 of the latter. In towns of from 20,000 down, private works have the strongest footing. The works in the "unknown" column are in towns not returned separately by the last census, so far as it is yet available, but it is known that they are mostly in places below 5,000. In Canada private works prevail in no class of towns.

The smaller number of private works in the larger towns is due to the feeling that the works can be best managed for all interests by the public and to the additional fact that the money for public works can be secured. The smaller places often lack power or credit sufficient to build works and are supplied by private capital. Very often extreme conservatism in the incurring of debt prevents the town from building works, or the privilege is granted to a company when the town is small, without thought except for the immediate future.

The relative growth of public and private works during the nine decades of this century is shown by Table 11-S., and graphically by Fig. 9. The table gives for each half-decade the number of works built, public, private and total; the total number of works of each class which had been built to the close of the several periods; changes in ownership; and

TABLE 9—S.

United States and Canadian Water-Works.—Summary by States and Groups of States of the Number of Public and Private Works, Total Number of Works, and Per Cent. of Public and Private to the Whole Number.

	No. of works.			Per cent. of total.			No. of works.			Per cent. of total.	
	Public.	Private.	Total.	Public.	Private.		Public.	Private.	Total.	Public.	Private.
Me	2	35	37	5.4	94.6	Ia	51	26	77	66 2	33.8
N. H	11	25	36	30.6	69.4	Minn	21	13	34	61.8	38.2
Vt	19	8	27	70.4	29.6	Kan	32½	46½	79	41.1	58.9
Mass	*82½	*45½	128	64.5	35.5	Neb	48	14	62	77.4	22.6
R. I.	5	9	14	35.7	64.3	S. Dak	17	5	22	77.3	22.7
Conn	14	34	48	29.2	70.8	N. Dak	5	2	7	71.4	28.6
						Wyo	3	6	9	33.3	66.7
New Eng.	133½	156½	290	46	54	Mont	0	11	11	0	100
N. Y	81	118	199	41.2	58.8	N. W	177½	123½	301	59	41
N. J	22	36	58	38	62						
Pa	51½	164½	216	23.8	76.2	Mo	4	32	36	11.1	88.9
Del	5	1	6	83	17	Ark	1	11	12	8.3	91.7
Md	4	14	18	22.2	77.8	Tex	20	40	60	33.4	66.6
D. C	1	0	1	100	0	Colo	33	24	57	57.9	42.1
						N. Mex	1	8	9	11.1	88.9
Mid	164½	333½	498	33.2	66.8						
						S. W	59	115	174	33.9	66.1
Va	20	21	41	48.8	51.2						
W. Va	5	5	10	50	50	Wash	10	28	38	26.3	73.7
N. C	3	12	15	20	80	Ore	11	15	26	42.3	57.7
S. C	1	6	7	14.3	85.7	Cal	10½	92½	103	10	90
Ga	11	10	21	52.4	47.6	Ariz	1	3	4	25	75
Fla	2	10	12	16.6	83.4	Nev	0	9	9	0	100
						Utah	3	4	7	42.9	57.1
S. Atl	42	64	106	39.6	60.4	Ida	1	9	10	10	90
Ala	1	19	20	5	95	Pac	36½	160½	197	18.6	81.4
Miss	1	6	7	14.3	85.7						
La	1	3	4	25	75	Total U. S.	878	1,159	2,037	43.1	56.9
Tenn	2	14	16	12.5	87.5						
Ky	5	18	23	21.7	78.3	N. B	3	2	5	60	40
						N. S	9	0	9	100	0
S. Cent.	10	60	70	14.3	85.7	P. E. I	1	0	1	100	0
						P. Q	13	11	24	54.2	45.8
O	58	28	86	67.4	32.6	Ont	31	17	48	64.6	35.4
Ind	27	23	50	54	46	Man	0	1	1	0	100
Mich	85	28	113	75.2	24.8	N. W. T	0	1	1	100	100
Ill	69	33	102	67.7	32.3	B. C	2	4	6	33.3	66.7
Wis	16	34	50	32	68						
						Tot'l Canada	59	36	95	62.1	37.9
N. Cent.	255	146	401	63.6	36.4						

* Fractional ownership denotes works owned jointly by city and company, of which there are but few instances.

TABLE 10-S.

United States and Canadian Water-Works.—Ownership Classified by Sizes of Towns for Each Group of States, the United States and Canada.

Group.	Above 100,000.		50,001 to 100,000.		20,001 to 50,000.		5,001 to 20,000.		Below 5,000.		Unknown.		All works.		
	Pub.	Pri.	Pub.	Pri.	Pub.	Pri.	Pub.	Pri.	Pub.	Pri.	Pub.	Pri.	Pub.	Pri.	T'tl.
New Eng.	1	..	7	1	16	5	48	50	57½	75½	4	25	133½	156½	290
Middle	11	2	6	4	12	12	49	73	80½	202½	7	39	164½	333½	498
S. Atl.	..	..	2	1	5	2	13	18	21	36	1	7	42	64	106
S. Cent.	..	2	1	1	2	8	4	15	3	31	..	3	10	60	70
N. Cent	6	2	5	1	13	8	67	80	156	51	8	4	255	146	401
N. W.	2	1	1	1	1	7	12	35	154½	79½	6	1	177½	123½	301
S. W.	1	3	..	1	3	6	4	34	46	58	4	14	58	116	174
Pacific	..	1	..	3	4	6	3	12	24½	119½	5	19	36½	160½	19[illegible]
Un'ed S's	21	11	22	13	56	54	200	317	543	653	35	112	877	1,160	2,03[illegible]
Canada	2	..	1	..	6	1	18	13	27	17	6	4	59	36	9[illegible]

finally the actual status at the end of each h alf decade. In connection with the above, proper percentages are given. The diagram shows the number of public and private works built to the close of each half-decade, this being indicated by the broken line, and also the actual number of works of each class at the several dates. In addition the heavy line in the diagram shows by ownership the present population of all towns having works at the close of each decade. In this part of the diagram the works in operation at the end of each period are represented by their present importance in point of population, it being assumed that the several towns have had the same population as now since their works were built. In other words, the element of growth of towns has been eliminated, and the number of works of each class has been weighted by the present population of the towns in which they are located.

Starting with but one public against 15 private works (see Eng. News, Dec. 5, 1891 for names and dates of construction) at the beginning of this century, the numbers have increased until in July, 1891, there were completed or under construction 878 public and 1,159 private plants. The corresponding percentages are 6.3 against 93.7, and 43.1 against 56.9. The relative changes in number of works has been occasioned both by the increase of public works and by the changes in ownership. Of the latter there have been 83 private plants which have become public, against only 17 changes from public to private. There were no changes from public to private ownership until between 1876 and 1880, but the opposite changes began early as 1810, when the works at Wilmington, Del., built in 1804 by the Wilmington Spring Water Co., were bought by the borough for $10,000. The number of changes in each half decade is shown in Table 11-S. The places in which changes have occurred, dates of changes, dates of construction and 1890 populations, are shown in Table 11½—S.

For convenience the number of changes in each group and the present populations involved in these changes have been brought together in the table following.

The Middle States lead both in number of changes from private to public and in the present population involved. The New England States come next in point of numbers, and the North Central in population. Boston is included in the New England, New York in the Middle, New Orleans in the South Central, and Chicago in the North

TABLE 11½—S.

List of Cities and Towns in the United States Where the Water-Works Have Changed Ownership, with Date of Change, Date Built and Population in 1890, Arranged by Groups in Order of Changes, Earliest to Latest.

Changes from Private to Public Ownership.

Works at:	Date of change.	Date built.	Population, 1890.	Works at:	Date of change.	Date built.	Population, 1890.
Boston, Mass	1848	1652	448,477	Baltimore, Md	1854	1807	434,439
Hartford, Conn	1854	1797	53,230	Trenton, N. J	1855	1803	57,458
Plymouth, Mass	1855	1796	[illegible]314	Cohoes, N. Y	1857	1848	22,509
Danbury, Conn	1861	1833	19,473	Newark, N. J	1860	1800	181,830
Worcester, Mass	1864	1796	84,655	Reading, Pa	1865	1821	58,061
Salem, Mass	1865	1799	30,801	Allentown, Pa	1865	1827	25,228
Cambridge, Mass	1865	1837	70,028	Buffalo, N. Y	1868	1852	255,664
New London, Ct.	1872	1802	13,757	Oxford, Pa	1870	1868	1,711
Peabody, Mass	1873	1799	10,158	Camden, N. J	1870	1853	58,313
Springfield, Mass	1875	1843	44,179	Bethlehem, Pa	1871	1761	6,762
Providence, R. I.	1870-6	1722	132,146	New Brunswick, N. J	1878	1868	18,603
Spencer, Mass	1884	1883	3,747	Burlington, N. J	1877	1804	7,264
Woonsocket, R. I.	1885	1884	20,830	Bradford, Pa	1881	1877	10,511
Dover, N. H	1888	1826	12,790	Edenburgh, Pa	1882	1880	1,202
Windsor, Vt	1888	1850	1,846	Slatington, Pa	1883	1861	2,716
Swanton, Vt	1889	1887	3,231	Schenectady, N. Y	1885	1871	19,902
Uxbridge, Mass	1890	1880	3,408	Gouverneur, N. Y.	1890	1867	3,458
Rochester, N. H	1891	1885	7,396	Richfield Sp'ngs, N. Y		1879	1,621
Braintree, Mass	1891	1887	4,848				
Milford, N. H	1891	1889	3,014				
Franklin, N. H	1891	1891	4,085				
Wilmingt'n, Del.	1810	1804	61,431	Lynchburg, Va	1828	1799	19,709
New York, N. Y.	1843	1774	1,515,301	Augusta, Ga	1861	1828	33,390
Frederick, Md	1844	....	8,193				
Kennet Sq're, Pa.	1850	1842	1,326	Huntsville, Ala.	1858	1836	7,995
Albany, N. Y	1851	17—	94,923	†New Orleans, La.	1868	1833	242,039
Detroit, Mich	1836	1827	205,876	Abilene, Tex	1887	1886	3,194
Cincinnati, O	1839	1820	296,908	Central Cy., Colo.	1889	1873	2,480
Chicago, Ill	1851	1842	1,099,850	Galveston, Tex	1889	1884	29,084
Jackson, Mich.	1871	1870	20,798	Berthoud, Colo	1889	1886	228
Moline, Ill	1886	1883	12,000	Lamar, Colo	1890	1887	569
Joliet, Ill	1888	1881	23,264	Georgetown, Colo.	1891	1874	1,927
Bessemer, Mich.	1890	1888	2,566	E. Dallas, Tex	1891	1886	38,067
Lewiston, Ill	1890	1888	2,166	Vernon, Tex	1891	1890	2,857
Hayward, Wis.	1890	1888	1,349	Cañon Cy., Colo.		1880	2,825
Galesburgh, Ill.	1891	1883	15,264	Ft. Worth, Tex.		1883	23,076
Huntingdon, Ind.	1891	1891	7,328				
Kenton, O	1892	1882	5,557	Portland, Ore	1887	1853	46,385
				Seattle, Wash	1889	1884	42,837
St. Paul, Minn., since	1882	1870	133,156	The Dalles, Ore	1890	1862	est., 3,000
Sauk Center, Minn.	1888	1884	1,695	Oceanside, Cal	1890	1886	est., 1,200
Bunker Hill, Kans.	1889	1876	157	Aberdeen, Wash.	1891	....	1,638
Springfield, Kans	1889	1889	347	*Portland, Ore	1891	1887	....
Fargo, N. D	1890	1887	5,664	Santa Cruz, Cal.	1891	1876	5,596
				Gilroy, Cal		1872	1,694

Changes from Public to Private Ownership.

Hoboken, N. J	1882	1855	43,648	Peoria, Ill	1889	1868	41,024
Chester, Pa	1888	1868	20,226				
Green Island, N. Y.	1888	1878	4,463				
Beaver, Pa	1891	1886	1,552	McPherson, Kan	1890	1883	3,172
				Beloit, Kan		1887	2,455
Manchester, Va.	1889	1840	9,244				
Orangeb'gh, S.C.	1889	1887	2,966				
				Sedalia, Mo	1887	1871	4,068
†New Orleans, La.	1878	1833	242,039	Cleburne, Tex	1891	1884	3,278
Lexington, Ky.	1884	1832	21,567				
Columbia, Tenn.	1884	1840	5,379				
Frankfort, Ky.	1886	1841	7,892	Ogden, Utah	1890	1882	14,889
Jacksonville, Ala.	1889	1883	1,257				

* East Portland, now part of Portland, first supplied in 1887 by a company. In 1891 another company built works, which were bought by town.
† Built in 1833 by company; bought by city in 1868; sold to company in 1878.

TABLE 11—S.

United States Water-Works.

Summary by Half-Decades of Public, Private and All Works Built; of Public and Private Works Built to Close of Each Period; Changes from Private to Public and from Public to Private; and Actual Number of Works at End of Each Half-Decade, Public, Private and Total.

	Works built. In each half-decade.					Works built. To close of each half-decade.				Changes in ownership.				Actual number of works at end of each half-decade.				
				Per c't of total.				Per c't of total.				Per c't of total.					Per c't of total.	
	Pub.	Priv.	Total.	P. c. pub.	P. c. priv.	Pub.	Priv.	P. c. pub.	P. c. priv.	Priv. to pub.	Pub. to priv.	Pub.	Priv.	Pub.	Priv.	Total.	Pub.	Priv.
Before 1801	1	15	16	6.3	93.7	1	15	6.3	93.7	..	..	....	....	1	15	16	6.3	93.7
1801-5	1	6	7	14.3	85.7	2	21	8.7	91.3	..	..	....	....	2	21	23	8.7	91.3
1806-10	2	1	3	66.7	33.3	4	22	15.4	84.6	1	..	3.8	....	5	21	26	19.2	80.8
1811-15	..	..	..	....	....	4	22	15.4	84.6	..	..	....	....	5	21	26	19.2	80.8
1816-20	..	4	4	....	100	4	26	15.4	84.6	..	..	....	....	5	25	30	16.6	83.4
1821-25	..	2	2	....	100	4	28	12.5	87.5	..	..	....	....	5	27	32	15.6	84.4
1826-30	3	9	12	25	75	7	37	15.9	84.1	1	..	2.3	....	9	35	44	20.5	79.5
1831-35	6	4	10	60	40	13	41	24.1	75.9	..	..	....	....	15	39	54	27.8	72.2
1836-40	6	4	10	60	40	19	45	29.7	70.3	2	..	3.1	....	23	41	64	35.9	64.1
1841-45	2	4	6	33.3	66.6	21	49	30	70	2	..	2.9	....	27	43	70	38.6	61.4
1846-50	4	9	13	30	70	25	58	30.1	69.9	2	..	2.4	....	33	50	83	39.7	60.3
1851-55	0	13	23	43.5	56.5	35	71	33	67	5	..	4.7	....	48	58	106	45.3	54.7
1856-60	17	23	50	23.3	76.7	42	94	30.9	69.1	2	..	1.5	....	57	79	136	41.9	58.1
1861-65	4	22	26	15.4	84.6	46	116	28.4	71.6	7	..	4.3	....	68	94	162	42	58
1866-70	43	38	81	53.1	46.9	89	154	36.6	63.4	5	..	2 1	....	116	127	243	47.7	52.3
1871-75	104	75	179	58.1	41.9	193	229	45.7	54 3	7	..	1.7	....	227	195	422	53.8	46.2
1876-80	65	111	176	35.9	63.1	258	340	43.2	56.8	2	1	0.3	0.2	293	305	598	49	51
1881-85	150	265	415	35.1	63.9	408	605	40.2	59.	7	3	0.7	0.3	447	566	1,013	44.1	55 9
1886-90	347	518	865	40.1	59.9	755	1,123	40.2	59 8	23	11	1.2	0.6	806	1,072	1,878	42.9	57.1
Unknown	0	14	14	....	100	..	..	....	....	5	..	....	....	....	....	....	....	....
July 1, '91	57	88	145	39.3	60.7	812	1,225	39.9	60.1	12	2	0.6	0.1	878	1,159	2,037	43.1	56.9
T't'l ch'nges	....	....	....	....	....	....	....	....	....	83	17	4.1	0.9	....	....	....	....	....

Group.	Private to Public. Number.	Private to Public. Population.	Public to Private. Number.	Public to Private. Population.
New England	21	984,513	....	.....
Middle	23	2,849,029	4	69,889
South Atlantic	2	53,009	2	12,210
South Central	2	250,034	5	278,105
North Central	12	1,692,926	1	41,024
Northwestern	5	141,019	2	5,627
Southwestern	10	104,304	2	7,346
Pacific	8	102,350	1	14,889
Total, U. S.	83	6,177,184	17	429,090

Central changes. Other large cities, named further on, were involved in these changes, so that the present population of changes to public ownership is 6,177,184, against 422,000 on the other side. In changes from public to private the South Central group leads, New Orleans also being included on have a net gain for private works of 35, which increased their percentage to 58. In the war period many of the cities North and South were contributing money directly and all indirectly to carry on the war, and consequently there were but few communities that had the means, and perhaps fewer until the market is better. Besides, hard times real or threatened, deter the mass of the citizens from incurring further municipal indebtedness when the money market is but little affected, while capitalists who make a business of building works are not always so much influenced by financial depressions.

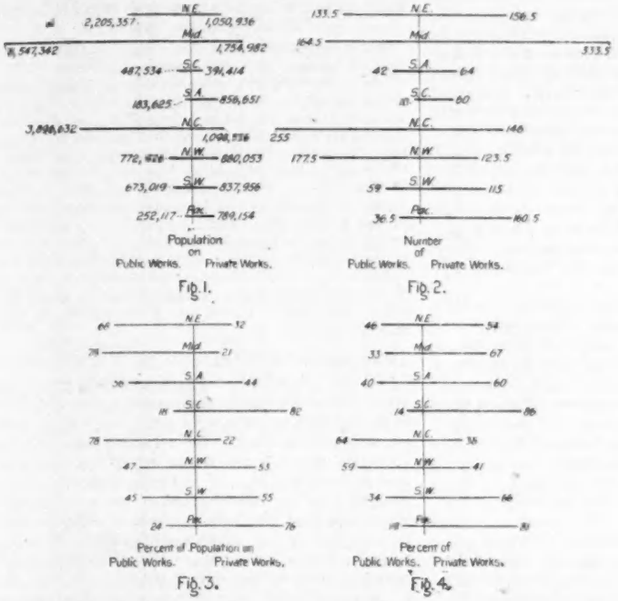


Fig. 1. Fig. 2. Fig. 3. Fig. 4.

United States Water-Works.—Diagrams Showing by Groups of States the 1890 Population on Public and Private Works in Operation or Under Construction July 1, 1891; Number of Public and Private Works; also Corresponding Percentages.

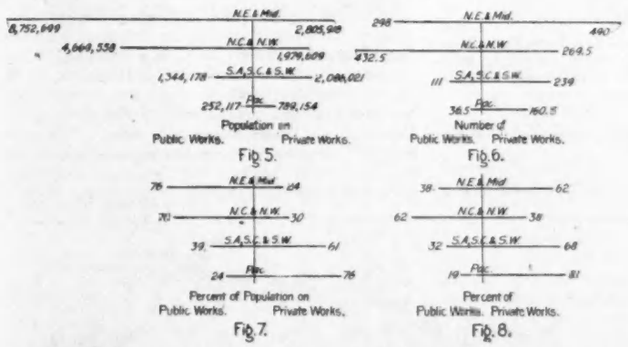

N.E. & Mid.
N.C. & N.W.
S.A.,S.C. & S.W.
Pac.
Population on Public Works. Private Works.
Number of Public Works. Private Works.
Percent of Population on Public Works. Private Works.
Percent of Public Works. Private Works.

Fig. 5. Fig. 6. Fig. 7. Fig. 8.

United States Water-Works.—Diagrams Showing by Four Great Groups of States the 1890 Population on Public and Private Works in Operation or Under Construction July 1, 1891; Number of Public and Private Works; also Corresponding Percentages.

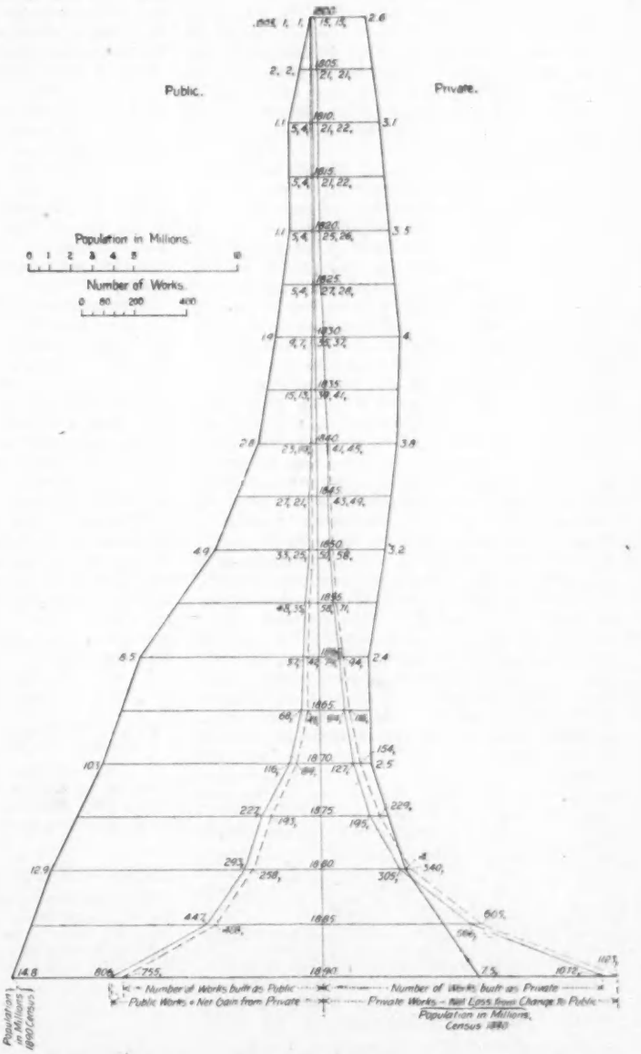

Public.
Private.
Population in Millions.
Number of Works.
Number of Works built as Public
Number of Works built as Private
Public Works + Net Gain from Private
Private Works − Net Loss from Change to Public
Population in Millions, Census 1890

Fig. 9.—Growth of Public and Private Water-Works in the United States.—Diagrams Showing the Number of Works of Each Class Built to the Close of Each Half-Decade and the Actual Standing After Changes in Ownership; also the Relative Importance of Works of Each Class at the End of Each Decade, According to Present, or 1890, Populations.

this side, its works having been built by a company in 1833, bought by the city in 1868 and sold to a company in 1878.

As will be seen by referring to Table 11-S, the greatest number of works to change from private to public in any one period was 23 in the last half-decade. The same may be said for the opposite changes, 11 works having changed from public to private in 1886-90.

Coming now to the actual status at the end of each period, we find public works relatively increasing from 1801-10, and gaining one by the change in ownership at Wilmington, Del., already noted. In 1811-15 all works were stationary and in 1816-25 no more public works were added, causing a fall in the percentage of public works. In 1830 public works had regained their relative importance and they continued to gain until 1855, when they had 45.3 per cent. of the total, or 48 against 58 private plants.

The years 1856-65, preceding and including the civil war, saw but 11 public works built, against 55 private, so that deducting these and the 9 works which changed from private to public ownership, we still the heart, to engage in local improvements. In 1863, as in the whole of the 1812 war period, not a works was built.

In the 10 years after the war public works gained rapidly in relative numbers, increasing from 42 to 53.8 per cent. of the total, standing above private works for the first and only period, the numbers being 227 public and 195 private in 1875. In each of the two last half decades public works have shown a relative decrease, standing at 42.9 per cent. of the total in 1890.

From the foregoing review it seems that public works gain on private with the general prosperity of the country. Public works are built almost wholly from the proceeds of bond issues, and these are generally sold at a lower rate of interest than company's bonds, and in some instances cannot by law be sold below par, and still less can they be sold at a low figure, because of popular feeling regarding the city's credit. Many private water-works put a fair proportion of cash from capital stock into their plants, and are probably not so averse to selling bonds below par; indeed, can sometimes hold bonds

In the last 10 years, also, promoters and parent companies have been active in constructing private works, one parent company controlling nearly or quite 40 local companies, another some 25 to 30, and several others from two or three to ten or thereabouts.

But just now the tide is setting strongly for municipal ownership, although the table does not show it, and with the building of new and the purchase of old works the next few years will probably see a considerable increase in both the relative number and importance of public works, unless indeed the late financial depression sets the tide more strongly the other way, which, considering its strength, is hardly probable.

In Canada up to 1845 there were but two works, both of which were public. In 1870, and again in 1875, there were 4 public and 4 private works. In 1880 public works had risen to 72.2 per cent., but they have since fallen and now stand at about 62 per cent. of the total. Altogether there have been 9 changes in ownership, all from private to public, as follows:

	Date of change.	Date built.	Population, 1891.
Montreal, P. Q.	1845	1801	216,650
St. John, N. B.	1855	1836	39,179
Halifax, N. S.	1861	1848	38,556
Toronto, Ont	1873	1841	144,028
Kingston, Ont.	1887	1851	24,269
Valleyfield, P. Q.	1887	1886	5,516
Niagara Falls, Ont.	1889	1856	3,349
Owen Sound, Ont.	1890	1880	7,497
St. Henri, P. Q.	1891	1880	13,415
Total population			492,459

The total number of works in Canada is 95, so that nearly 10 per cent. of all works have changed from private to public ownership, and it may be added that some 45 per cent. of the present population on works is supplied by the plants included above.

The growth of public and private works and changes of ownership in the United States is best shown by the diagram, Fig. 9, especially the relative importance of the two classes at any time, this being indicated by the heavy lines in the diagram. As has already been explained the broken lines in the diagram represent public and private works as they would have been without changes in ownership, while the full light lines show the actual status of each class, with changes. The changes began in 1830, but cannot be shown on the diagram until 1840, owing to the small number of works at that time. The population diagram shows the changes from 1830 to 1860 in a very forcible way. It was in these 30 years that the largest cities (see the list below) in the country went over from private to public ownership, causing, together with a more rapid increase in population supplied by public works, private populations to fall from 4 millions in 1830 to 2.4 millions in 1860, and public populations to rise from 1.9 to 8.5 millions. It took until 1880, or 50 years, for private works to regain, present populations considered, it must be remembered, the standing they had in 1830, while in 1890 public works had risen to 12.9 millions and in 1890 to 14.8 against 7.5 millions, a little over half, on private works, the figures for 189 being the actual populations in that year. Of the 50 largest cities of the United States 17 have changed from private to public ownership, as follows, the places being arranged in order of dates of changes:

	Date of change.	Present population		Date of change.	Present population
Wilmington, Del.	1810	61,431	Newark, N. J.	1860	181,830
Detroit, Mich.	1836	205,876	Worc'st'r, Mass	1864	84,655
Cincinnati, O.	1839	296,908	Cambridge, Mass.	1865	70,028
New York, N.Y.	1842	1,515,301	Reading, Pa.	1865	58,661
Boston, Mass.	1848	448,477	Buffalo, N. Y.	1868	255,664
Albany, N. Y.	1851	94,923	NewOrleans, La	1868	242,039
Chicago, Ill.	1854	1,099,850	Camden, N. J.	1870	58,313
Baltimore, Md.	1854	434,439	St. Paul, Minn.	since 1882	133,156
Trenton, N. J.	1855	57,458			

It is interesting to note in connection with the above that only 12 of the 50 largest cities of the United States are now supplied wholly by companies, the cities being as follows, in order of size:

San Francisco, Cal.	298,997	Denver, Colo	106,713
New Orleans, La.	242,039	Indianapolis, Ind	105,436
Louisville, Ky. (city owns practically all the stock)	161,129	Syracuse, N. Y.	88,143
		New Haven, Conn.	81,298
Omaha, Neb	140,452	Paterson, N. J.	78,347
Kansas City, Mo.	132,716	Scranton, Pa.	75,215
		Memphis, Tenn	64,495

Thus 29 of our 50 largest cities were once supplied by private companies and now all but 12 have their works under public ownership.

In addition to the above, Brooklyn, Pittsburg and Grand Rapids have a part of their population supplied by companies, but the part so supplied is less than 4 per cent. of the total population in Brooklyn, probably less than 25 per cent. in Pittsburg and less than half at Grand Rapids.

A list of 29 duplicate and triplicate plants in 25 cities was given in Engineering News for Nov. 28, 1891, and further comment upon competing plants was promised.

These duplicate works are so circumstanced that there is, with two or three exceptions, little or no real competition between them, or the works in themselves are very small. In Brooklyn the Long Island Water Supply Co. supplies an annexed part of the city, the 26th Ward. These works were built before annexation—it has been hinted to sell to the city, as those familiar with what the New York papers termed the "Brooklyn water-works scandal" will remember. At Jamaica the two companies are practically under the same management, and have been from the first, the second company supplying water to the first. At Pittsburg the Monongahela Water Co. supplies the citizens on one side of the river and an outside population, the whole aggregating about 75,000, while the city supplies the greater part of its inhabitants. At Mobile the first company built works in 1840, and a larger plant was built by a company in 1888. These are evidently competing, as the second company went to the courts to prove its exclusive right to supply the city, but failed in the attempt. At Chattanooga the second company supplies a different section of the city, or at least is on amicable terms with the first, since it buys water from it and repumps it. At Grand Haven and Grand Rapids, each, there is a public and private plant, and in the latter city the two are in lively competition. At Chicago the private plant is in the former village of Pullman, now a part of Chicago, and was built to supply various industries and the dwellings of the Pullman Palace Car Co. At Denver there is bitter rivalry between the two companies, the second being the outgrowth, according to reports, of a quarrel among the stockholders of the first.

At Seattle the present city plant was built by a company and recently bought by the city. The other, and private plant, is small, and may yet be bought by the city. In Spokane the private plant supplies a small suburb and in Portland the companies operate in districts annexed within a very short time, while one of the companies had a public works for a rival before annexation. At Los Angeles the third company is small and does not compete with the other two, while it seems that there may be some rivalry between the first two.

From the above review it will be seen that among American water companies competing plants play scarcely any figure, the works in most cases being small, or occupying independent territory, or both. There has been some competition and consolidation, but a water supply system, of any size, is one of the most complete of natural monopolies and almost defies competition.

LETTERS TO THE EDITOR.

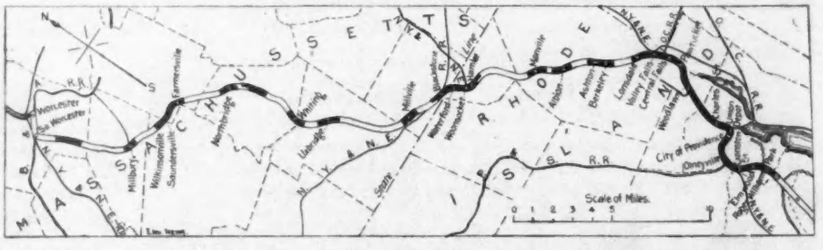
THE PROVIDENCE & WORCESTER BLOCK SIGNAL SYSTEM.

Sir: I send you herewith map of New York, Providence & Boston R. R. system, showing the portion of the road protected by automatic electric block signals, which is indicated by black areas or sections. Yours truly,

E. P. Dawley,
Chief Engineer, N. Y., P. & B. R. R.

Providence, R. I., Jan. 15, 1892.

[We reproduce only the Worcester Division of this line, where the block signal plant has been in use since 1881-3. The remainder of the road is protected in about the same way, but the plant is of somewhat later date. The parts of the line (which is all double track) colored black are where an electric circuit is maintained through the rails themselves, so that any broken rail, hand car on track, or switch open, as well as any cars on the track, will throw the block signals to danger. On the remainder of the road the protection is only against trains, but then, in these open sections between stations, there are no switches to be left open, and all that the block system proper attempts to do is to protect against trains. That protection is as perfect in the open sections as on the black sections, since the signals are connected together electrically as a continuous series. Each train as it enters one of the white sections of track protects itself and is protected in the automatic action of the signals, but it has no protection on the white sections against a broken rail. In view of the importance of this plant as a precedent, it is desirable that the very complete character of the protection which it affords should be fully understood. The plant is simply a complete automatic block signal system and something more besides, which latter is usually attainable only by interlocking.—Ed.]



THE WORCESTER DIVISION OF THE NEW YORK, PROVIDENCE & BOSTON R. R. (THE SOLID BLACK INDICATES PARTS OF LINE PROTECTED BY AUTOMATIC ELECTRIC BLOCK SIGNALS.)

THE CENSUS AND INTERSTATE COMMERCE GROUPING OF STATES.

Sir: In your letter of 16th inst. I observe that on p. 65 you refer to the United States census as having adopted (apparently referring to its compilation of railway statistics) a subdivision of the United States into five groups. Is there not some misunderstanding with regard to this? It is not my province to take up matters relating especially to the compilation work of the Eleventh Census, but to my certain knowledge the subdivision of the United States is, for the purpose of compiling railway statistics the same as used by the transportation division of the Census Office and as used by our own office of the Interstate Commerce Commission. You will remember that Mr. Adams, who is the Statistician of the Commission, is also in charge of the transportation division of the Census Office. Thinking that you would like to have this called to your attention, I beg to remain very respectfully yours,

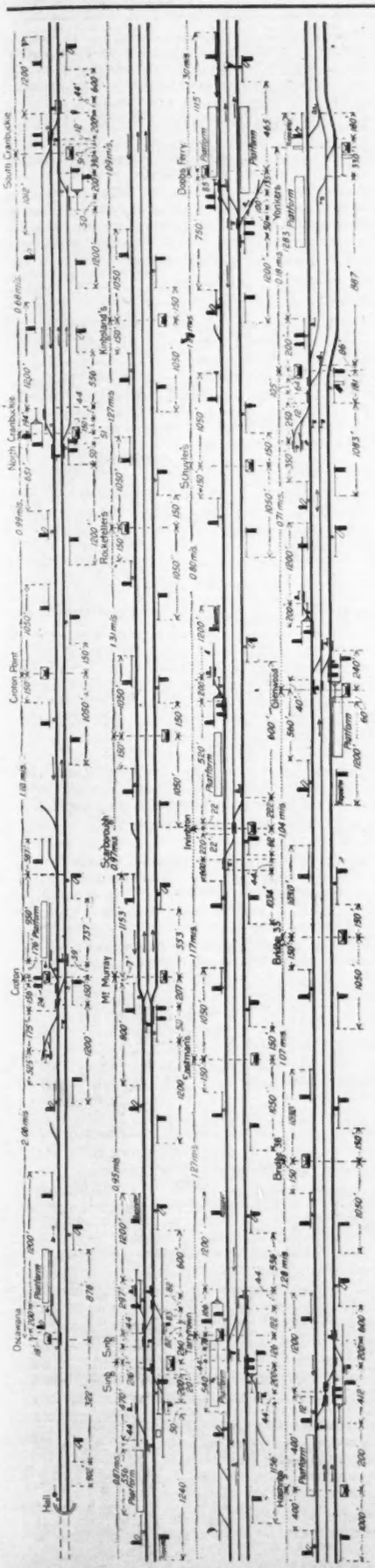
James A. Case,
Washington, Jan. 18, 1892. Asst. Statistician.

[We did not refer to the census railway grouping, which we were aware corresponded in part at least to the Interstate Commerce grouping, but to that adopted by the census for all other but railway statistics, which is, as stated, admission into five groups instead of 10, and radically different otherwise, so that no combination of one set of groups (otherwise than all of them together) will make any combination of the other set of groups. It is an immense advance that there should be any grouping at all, and we are duly thankful for it, but it is a thousand pities that no attention was paid to avoiding the confusion between three sets of groupings pointed out last week, as might easily have been done.—Ed.]

THE SYKES BLOCK SIGNAL SYSTEM BETWEEN YONKERS AND OSCAWANA, NEW YORK CENTRAL & HUDSON RIVER R. R.

As we have before stated, the Johnson Railroad Signal Co., of Rahway, N. J., is establishing block signals on the New York Central & Hudson River R. R. from Yonkers north to Oscawana, 21 miles, and has been awarded the contract for the section from Peekskill to Poughkeepsie, 31 miles. We show herewith the plan of the tracks, signals and signal towers between Yonkers and Oscawana. The Sykes system of blocking is the one adopted, and while it is familiar to many of our readers and we have before given descriptions of it, an explanation of its general principles may be of interest at this time.

The essential principle of the block system is the division of each main track into blocks or sections, in each of which only one train at a time is permitted. In the original and still most common form of the system, a man is stationed at the beginning of each block, whose duty it is to warn approaching trains whether the block ahead is occupied or clear. This man may be the telegraph operator at stations on roads of little traffic; but where the traffic is heavy, and the blocks are of short length, special signalmen are employed, a signal cabin is erected for their use, and fixed signals by the side of the track are provided, which may be worked from the cabin. Of course, connection by electric wire between the adjacent signal cabins is an essential of the block system. It is by this that the signalman learns from the next man ahead whether the train



BLOCK SIGNALS FOR THE NEW YORK CENTRAL.

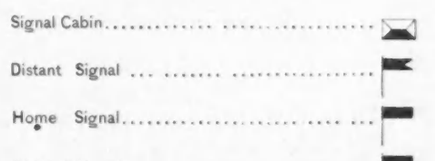
which he has seen pass into his block has passed out of it, so that he may turn his signal to safety and permit the passage of a following train.

But besides protecting the train from collisions, the block system can protect it from derailment at open switches. In the automatic block system this is done by electrically connecting all the switches in a block so that the signal can only stand at safety when the switches are all closed and locked. In the man-operated block system, which is here illustrated, a semaphore signal is placed at every switch to indicate whether the switch is open or closed. (In cases where several switches are close together, one home signal is used to govern them all.) A distant signal is also placed far enough away to permit the stoppage of a train, and warns the engineer of the position of the switch. In the system shown herewith, the semaphore on the distant signal post of the block system indicates also the position of the home signals at the switches.

At any point where there are both switch and block signals, the system admits of a train standing at the block signal, under the protection of the switch signal, and at the same time gives freedom to clear the section in the rear, permitting a train to approach up to the switch signal, or to take another non-conflicting track.

The main line switches, the signals which indicate their position, and the block signals are all controlled

EXPLANATION OF SIGNS.



by levers arranged in an interlocking machine in the signal cabin. These levers are so interlocked that no switch can be opened until the home and distant signals which indicate its position are set at danger; in fact the well known principle of interlocking, that a signal cannot be set at safety until the track which it governs is clear and all switches are locked, is carried out in full in designing all the interlocking at each of the signal stations.

Beside the main line switches the yard switches nearest the main line are at many of the stations controlled from the signal tower. Switches which are never used by main line trains have their position indicated by dwarf semaphores; and dwarf semaphores are also provided to govern reverse movements over main line switches.

To control these various switches and signals requires at some of the stations an interlocking machine of 20 or more levers, including the spare levers provided for additional switches which may in future be required.

All block signals located at stations where there are switches governed by semaphores are "slotted," that is, are arranged to go automatically to danger on the passage of a train and are locked in that position until the train passes out of the block. This is accomplished by insulating a short section of the track and electrically connecting it with the block instrument. These track circuits are indicated on the accompanying chart by small circles close to the rail, just past each block signal. (By mistake the track circuit on the northbound track at South Crawbuckie and on the southbound track at North Crawbuckie were omitted from the chart.) The slotting of the signal thus prevents a train which may be standing on the side track from entering the section ahead until it is clear. At Oscawana the home signal is slotted, although there are no switches, and the distant signal on the southbound track is also slotted. This is on account of the change at this point from the Sykes system to the Hall automatic. The object is to prevent the distant signal from showing clear when a train is standing at the platform, the automatic signal having been cleared by the passage of the train.

At block signal stations where there are no switches and the view is unobstructed, the home signal for each track is set 150 ft. beyond the signal cabin, and the distant signal is 1,200 ft. in front of the home signal. Where there are main line switches, the distant signal is set at least 1,200 ft. distant from the semaphore opposite the switch. In general all signals are placed where they can be seen from the signal cabin. In the few cases where this is impracticable the signal is electrically connected with a "repeater," a miniature semaphore located in the signal cabin, which repeats automatically each movement of the large semaphore for the information of the operator.

So much for the information given on the chart. We will add, for the benefit of those unfamiliar with the subject, a brief explanation of the Sykes system of interlocking the signal levers controlling the signals of successive blocks, so that an operator cannot by mistake give a clear signal before the train has passed out of the block.

The ordinary Sykes system requires the concurrence of three successive operators to admit a train onto an occupied block. But in the system to be installed between Yonkers and Oscawana an advance has been made upon this, and the electric locking is so arranged that it is impossible for an operator to admit a train to an occupied block, even with the concurrence of any number of operators.

Each lever used for working the block signals has an electric lock attachment which holds it normally in the danger position. This attachment, which consists of an electro-magnetic device, is not under control of the operator, but is controlled by the operator in the next signal cabin ahead by an instrument called a "plunger." One stroke of this plunger releases the lock in the preceding cabin and allows the operator there to pull his signal to safety and let the train pass. But the plunger in each cabin is so interlocked with the signal levers there that the plunger can only be worked once for each forward and back movement of the signal lever, and for each passage of a train over the track-circuit at the home signal Further, as described above, the signals at a cabin must be brought to danger every time a train passes it; if the signalman neglects it, the train will do it automatically.

Suppose now that with all levers in a series of signal cabins, 1, 2 and 3, locked in the normal position of danger, and no trains between 1 and 3, a train is announced as approaching No. 1. The operator at that cabin asks No. 2 to "plunge," so that he can move his own signal to the safety position and let the train pass. No. 2 does this, and No. 1 turns his semaphores to safety and the train runs by. Immediately No. 1 returns his signals to the danger position (if he neglects it for any reason the passage of the train turns them to danger). As soon as they go to danger they are locked automatically in that position and cannot be unlocked except by a new movement of the plunger by No. 2. Ordinarily, of course, the train proceeds, and the same operation is repeated at each station. Suppose, however, it stops somewhere in the block between No. 1 and No. 2, and a following train approaches No. 1. The operator there asks No. 2 to plunge provided the train has passed No. 2. But No. 2, if he has his wits about him, replies that the first train is still in the block between 1 and 2.

But perhaps No. 2's mind is not on his business. He forgets that the train has not yet passed him, or that No. 1 has admitted a train into the block at all, and attempts to plunge. But he finds the plunger locked fast. He cannot release it until No. 3 plunges and permits him to bring his own signal to safety and back to danger, and not even then unless the train has passed over the track circuit at the end of the block. Remembering that the apparatus is designed throughout to show a danger signal in case of any breaking or derangement of the mechanism, it seems plain that the arrangement leaves practically no loophole for accidents to occur through mistakes of signalmen.

THE INTERSTATE COMMERCE COMMISSION'S STATISTICAL REPORT.

[Concluded from page 67.]

The total capitalization of the 156,404 miles of railway reporting is given as $9,437,353,372, or an average of $60,340 per mile. This capitalization is the total of stocks, bonds and all other forms of indebtedness; but as an offset to this the several railway companies own stocks and bonds aggregating $1,406,907,000, and have on hand cash and bills receivable amounting to $318,392,734. This reduces the actual capitalization of railway property to $7,712,053,638, or an average of $49,310 per mile of road. In Table VI., which shows the average capitalization per mile in each territorial division, the Washington. The explanation of this over capitalization will be found in that series of accidents, mismanagements, and shrewd managements which make up the history of railway development in the United States. There is no question of more vital importance to the policy of Government control over railway affairs than the one thus brought into prominence. The rule of just compensation for railway service generally accepted by railway commissions can never be worked out satisfactorily until it is possible to convert the actual capitalization of lines into a just value of their property. The creation of a special commission for this purpose might with propriety be urged upon Congress.

The average rate of dividend on railway stocks in the several divisions is shown in Table VII., which ought to be studied with some interest by foreign Great Britain. The railways occupying the belt between Chicago and the Hudson River, and extending from the great lakes to the Ohio on the north and south, have a freight traffic which is not paralleled over a similar extent of territory in any country of the world. It is noteworthy that the average tonnage per freight train for the whole country shows a decrease, being 175.1 tons in 1890, against 179.35 tons in 1889. Poor's Manual gives a little less than 164 tons as the average for 1890, and 159 tons in 1889, or an increase of about the same amount as the decrease shown by the interstate statistics. It is common knowledge that the average freight train load is increasing, and the contrary showing of the

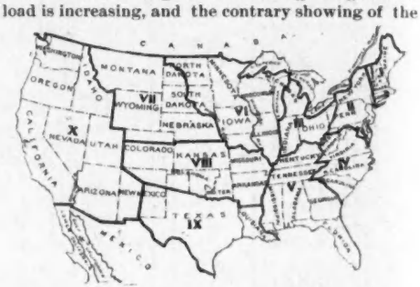
Table VI.—Average Capitalization per Mile of Railways in Each Territorial Division (No Deductions Being Made for Assets in the Shape of Stock and Bonds Owned, or Cash and Current Assets).

	Stock.	% of total.	Funded debt.	% of total.	Total cap'l.*
I. New England	$27,829	54.7	$19,412	38.2	$50,834
II. Middle	51,698	43.8	58,275	49.4	117,902
III. Cen. Northern	29,059	46.4	30,085	48.0	62,641
IV. South Atlantic	21,897	46.2	22,881	48.2	47,434
V. Ky., Tenn. & Gulf	20,640	44.1	24,432	52.2	46,775
VI. Northwest	22,567	47.4	23,674	49.7	47,645
VII. Rocky Mt'n	20,311	40.4	27,491	54.6	50,314
VIII. Central Western	22,992	46.5	24,295	49.1	49,461
IX. Southwest	21,678	46.4	23,393	50.1	46,691
X. Pacific	48,128	55.3	35,845	41.2	87,104
Total U. S.	$28,193	46.7	$29,250	48.5	$60,340

* The total capital is made up of (1) stock, (2) funded debt, (3) floating debt.

Table VII.—Percentages of Total Stock in Each Territorial Division Paying Various Rates of Dividend.

	Nothing paid.	1% to 3%.	3% to 5%.	5% to 7%.	7% to 9%.	9% and above.
I. New Eng.	24.6	10.7	1.4	19.3	25.3	18.7
II. Middle	47.3	9.3	12.6	25.2	10.7	3.9
III. Cen. No'n.	63.5	3.3	6.5	16.8	9.1	0.8
IV. So. Atl.	70.8	0.3	20.6	5.1	0.3	3.4
V. Ky. T. & G.	67.0	0.7	5.7	20.7	4.5	1.3
VI. Northwest.	63.9	0.6	14.0	15.1	6.0	0.4
VII. R'ky M't'n.	63.7	....	34.0	2.3	....	....
VIII. Cen. W'n.	72.9	7.8	17.6	1.0	0.6	0.1
IX. Southwest.	100.0	....	....	....	....	....
X. Pacific	83.5	13.8	2.7	....	....	....
Total U. S.	63.8	3.6	11.1	13.2	6.2	2.1



Subdivisions of the United States Adopted by the Interstate Commerce Commission's Statistician.

Table VIII. Average Passenger and Freight Traffic per Mile of Line and per Train in Each Territorial Division.

	Per mile of line. Pass. mileage.	Frt. ton mileage.	Pass. engers per pass. train.	Tons frt. per frt. train.	Aver. pass. journey, miles.	Average length of haul per ton, miles.
		1 = 1000.				
I. New England	234	384	62	122.3	15.66	69.04
II. Middle	183	1,348	45	218.3	16.73	96.39
III. Central Northern	86	794	37	217.6	30.64	120.94
IV. South Atlantic	43	331	33	162.0	38.36	170.20
V. Ky., Tenn and Gulf	47	365	36	138.5	36.35	107.11
VI. Northwest	50	376	35	148.3	32.32	135.40
VII. Rocky Mountain	46	270	41	150.3	78.95	167.83
VIII. Central Western	37	244	35	148.5	51.65	172.01
IX. Southwest	34	246	37	123.7	58.70	224.08
X. Pacific	67	192	56	123.0	33.43	193.55
United States	76	487	41	175.1	24.06	119.72

Table XI. Cost and Revenue per Unit of Traffic in Each Territorial Division.

	Per Passenger Mile. Revenue, cts.	Cost, cts.	Profit. cts.	Per Passenger Train Mile. Revenue. $	Cost. $	Profit. $	Freight per Ton Mile. Revenue, cts.	Cost, cts.	Profit, cts.	Per Freight Train Mile. Revenue. $	Cost. $	Profit. $
I. New England	1.912	1.463	.449	1.307	.902	.406	1.373	.949	.424	1.707	1.163	.545
II. Middle	2.029	1.765	.264	1.076	.803	.274	.828	.524	.304	1.818	1.150	.667
III. Central Northern	2.199	1.896	.303	.988	.712	.275	.695	.470	.225	1.525	1.026	.499
IV. South Atlantic	2.481	2.147	.334	1.023	.730	.293	.844	.571	.273	1.103	.946	.457
V. Ky., Tenn and Gulf	2.465	2.077	.388	1.009	.719	.289	1.031	.705	.326	1.495	.989	.505
VI. Northwest	2.226	2.071	.155	.962	.729	.233	.961	.593	.368	1.485	.906	.579
VII. Rocky Mountain	2.452	2.389	.063	1.262	.977	.285	1.360	.713	.647	2.036	1.066	.969
VIII. Central Western	2.298	2.294	.026	.989	.805	.184	1.152	.719	.433	1.712	1.068	.644
IX. Southwest	2.583	2.736	.153	1.189	1.035	.155	1.303	.961	.342	1.635	1.202	.433
X. Pacific	2.308	2.118	.190	1.599	1.241	.358	1.651	1.034	.617	2.036	1.273	.764
United States	2.167	1.917	.250	1 080	.810	.271	.941	.604	.337	1.654	1.057	.597
" " 1889	2.165	1.993	.172	1.063	.831	.232	.922	.563	.329	1.654	1.065	.589
" " 1888	2.349	2.042	.307	1.140	.847	.293	1.001	.630	.371	1.657	1.209	.518

Table IX.—Earnings and Income Account per Mile of Railway in Each Territorial Division.

	Gross earnings per mile.	Percentage of gross earnings assignable to various traffic. Pass.	Mail.	Express.	Freight.	Other.	Net earnings per mile.	Net income per mile.	Total dividends per mile.	Surplus or deficit per mile.	Value at 5% on earning capacity per mile.
I. New England	$10,444	43.5	1.7	2.4	51.4	1.1	$3,369	$1,725	$1,446	+ $279	$57,867
II. Middle	15,829	23.9	1.4	1.9	70.3	2.4	5,554	2,458	1,793	+ 665	109,741
III. Central Northern	7,785	24.4	2.5	1.9	69.3	1.9	2,463	839	590	+ 249	45,941
IV. South Atlantic	4,279	25.6	3.6	1.7	66.9	2.2	1,336	203	272	— 69	25,177
V. Ky., Tenn. & Gulf	4,945	24.9	2.4	1.9	67.8	3.1	1,667	350	403	— 103	30,206
VI. Northwest	5,195	22.6	2.5	1.8	71.0	2.1	1,871	574	464	+ 110	36,406
VII. Rocky Mountain	5,128	22.2	3.3	2.0	71.2	1.4	2,121	565	307	+ 258	38,136
VIII. Central Western	4,056	21.1	2.6	2.3	70.0	4.1	1,443	172	225	— 53	27,168
IX. Southwest	4,331	20.0	2.2	1.7	74.4	1.7	1,053	— 163	1	— 164	14,593
X. Pacific	5,836	30.8	2.6	1.5	61.7	3.4	1,965	— 664	172	— 836	22,672
United States	$6,725	25.3	2.2	1.9	68.2	2.4	$2,300	$651	$574	$77	$42,574
U. S., 1889	6,290	26.8	2.3	2.1	66.8	2.1	2,087	661	535	126	.....

Table X.—Operating Expenses per Mile of Railway in Each Territorial Division.

	Operating expenses per mile.	Percentage assignable to: Maintenance of Way and structures.	Maintenance of Equipment.	Conducting transportation.	Miscellaneous.	Per cent. assignable to Frt. traff.	Per cent. assignable to Pass. traff.	Per cent. of operating expenses to oper. income.
I. New England	$7,075	22.6	15.9	53.4	8.2	51.6	48.2	67.76
II. Middle	10,275	20.9	17.8	52.1	9.2	68.3	31.4	64.92
III. Central Northern	5,322	20.6	18.4	51.2	9.9	69.3	30.7	68.36
IV. South Atlantic	2,886	26.5	15.8	46.6	11.1	67.2	32.8	67.44
V. Ky., Tenn. & Gulf	3,278	22.2	16.0	49.9	11.9	68.2	31.8	66.29
VI. Northwest	3,324	21.0	15.3	51.1	12.6	67.3	32.7	63.98
VII. Rocky Mountain	3,607	21.4	17.1	51.0	10.6	66.0	34.0	58.64
VIII. Central Western	2,613	24.9	15.8	49.2	10.1	67.6	32.4	64.43
IX. Southwest	3,278	27.1	13.5	50.1	8.6	72.4	27.6	75.70
X. Pacific	3,871	24.5	13.2	52.3	10.0	58.0	42.0	66.32
United States	$4.425	22.1	16.5	51.2	10 3	66.4	33.6	65.80
U. S., 1889	4,203	22.5	16.6	51.3	9 7	65.1	34.9	66.81
U. S., 1888	4,346	22.6	17.1	50.3	10.1	66.4	33.6	65.34

Table XII.—Summary of Accidents to Persons on Railways of the United States for the Year Ending June 30, 1890.

	Employees. Trainmen. Killed.	Trainmen. Inj.	Switch-, flag-, and watchmen. Killed.	Switch-, flag-, and watchmen. Inj.	Other employees. Killed.	Other employees. Inj.	Total employees. Killed.	Total employees. Inj.	Passengers. Killed.	Passengers. Inj.	Others. Trespassing. Killed.	Others. Trespassing. Inj.	Others. Not trespassing. Killed.	Others. Not trespassing. Inj.	Others. Total. Killed.	Others. Total. Inj.	Total, all classes. Killed.	Total, all classes. Inj.
Coupling and uncoupling	265	6,073	75	1,528	29	241	369	7,842	....	....	....	....	....	....	....	....	369	7,842
Falling from trains and engines	456	1,838	32	213	73	312	561	2,363	....	....	....	....	....	....	....	....	561	2,363
Overhead obstructions	81	313	3	18	5	14	89	345	....	....	....	....	....	....	....	....	89	345
Collisions	157	806	3	22	25	146	235	1,034	44	527	23	26	2	40	25	76	304	1,637
Derailments	121	572	2	30	27	121	150	723	38	669	7	15	4	28	11	43	199	1,475
Other train accidents	69	574	16	60	61	197	146	831	31	211	288	307	22	66	310	373	487	1,415
At highway crossings	5	20	13	7	4	7	22	34	3	8	98	151	301	516	399	667	424	709
At stations	35	298	15	43	48	359	98	740	42	347	291	320	51	117	342	467	482	1,554
Other causes	230	2,618	75	386	449	5,244	781	8,484	128	663	2,355	2,183	129	164	2,511	2,580	3,420	11,727
Total	1,459	13,172	234	2,307	731	6,681	2,451	22,396	286	2,425	3,062	3,042	509	1,131	3,598	4,106	6,335	29,027

deduction for stocks and bonds owned is not made. In considering the contrast in capitalization in the different groups, it is to be remembered that difference in volume of traffic, and cost of equipment, extra trackage and terminals, is one cause of the differences in the capitalization in different groups. The other cause is referred to as follows by the statistician:

> The only roads that approach those of the Middle States in capitalization are the roads in California, Oregon and

investors in American railway shares. The fact that nearly two-thirds of all the stock outstanding paid no dividend during the year is by no means reassuring to investors in new railway lines.

Traffic.—The vast difference in the traffic of railways in different sections of the country is shown in Table VIII. New England railways, with their light, short haul freight traffic and enormously heavy passenger traffic, are working under conditions similar to those controlling the railways of

interstate statistics is probably due to some erroneous method of making up the figures, or a thin traffic during the period covered by the report. It is to be expected that the average freight train load will fluctuate somewhat with the volume of traffic. A year in which enormous crops have to be moved should show a heavier average train loading than a year of scanty harvests.

The totals of traffic for the whole United States for 1890 and 1889 are as follows:

	1890. (1=1000)	1889. (1=1000).	Increase (1=1000)
Passengers carried	492,431	472,171	20,260
" " one mile	11,847,786	11,553,820	293,965
" train mileage	285,576	277,241	8,335
Tons freight carried	636,542	539,640	96,902
" " one mile	76,207,047	68,727,223	7,479,824
Freight train mileage	435,170	383,201	51,970

Earnings and Expenses.—The income account of all the railways reporting to the Commission, aggregating 156,404 miles, shows the following totals:

	1890. (1=1000)	Increase over 1889, (1=1000)	Per mile of line. 1890.	Per mile of line. Increase over 1889
Gross earnings	$1,051,978	$87,062	$6,725	$435
Operating expenses	692,094	47,387	4,425	222
Income from operation	359,784	39,675	2,300	213
Surplus (after paying int'r'st and div'nds).	12,070	−7,387	77	−49

Of much greater interest, however, is the record of earnings per mile of road in the different territorial divisions, which is given in Table IX. We have already seen the great diversity in the volume of traffic in different sections of the country, but there is even greater diversity in the earnings. It is an excellent example of the familiar fact that it is additional traffic which pays profits. The last column gives an estimate of the average value of the railway property in each territorial division. It is based on a capitalization at 5% of the net earnings available for dividends plus the total amount of interest paid on bonds and other debts. Remembering that in the Middle States, where the average value of railway property on this basis is nearly $110,000 per mile, there is a great mileage of small local roads having very light traffic, the enormous earning power of the great trunk lines and coal carrying roads in this section is apparent. At the other extreme is the Southwest. With an average value, based on earning capacity, of but $14,000 per mile, it is little wonder that railway building in that section is not active.

Table X., giving operating expenses per mile of road in each territorial division, shows great variation in the actual amount in different parts of the country, but surprisingly little in the proportion due to the different departments of the service. It might be expected that the light traffic railways of the West and South would have a much larger proportion of their expenses due to maintenance of road and structures, and a much smaller proportion due to train service than the heavy traffic railways of the North and East. The difference, however, is very small. The economies in train service due to heavy traffic seem to be as great as those due to a greater use of the road. The percentage of operating expenses to income from operations is also remarkably uniform, with the exception of Group VII. (Montana, Wyoming and Nebraska), where it is only 58.6%, and Group IX. (Texas and Louisiana), where, for some reason not apparent, it rises to 75.7%, or 10% higher than the average of the United States.

The percentage of expenses assignable to freight and to passenger traffic is also more uniform than might be expected. This assignment is made on a train mileage basis.

Table XI., showing the cost and revenue per unit of passenger and freight traffic, emphasizes again the influence of volume of traffic as a factor in cost of carriage. It may well be studied in connection with Table VIII., showing the train loads and average haul in each section. The interesting comparisons which may be made from this table are very numerous. We may note that in Ohio, Indiana and Michigan, where the average freight train load is 218 tons, the cost per freight train mile is much less than in the territory west of the Mississippi and Missouri, where train loads are from 123 to 150 tons. In passenger traffic, New England, with the lowest rates, has the highest profit per passenger mile and per passenger train mile. Texas and Louisiana, with the highest rates, show a loss per passenger mile of 1½ mills and the lowest profit per passenger train mile of any division.

Railway Accidents.—These statistics show a decrease in the accidents to passengers, but a large increase in accidents to employees over the two previous years, as follows:

	Killed. 1890	1889	1888	Injured. 1890	1889	1888
Employees	2,451	1,972	2,070	22,304	20,028	20,148
Passengers	286	310	315	2,425	2,146	2,138
Others	3,597	3,541	2,897	4,206	4,135	3,602
Total	6,334	5,823	5,282	29,025	26,309	25,888

Considering the increase in traffic and in mileage which has taken place during the above years, the showing is on the whole a very good one for passenger accidents, especially as part of the increase in injuries may be due to greater care in reporting them.

Table XII., summarizes the accidents according to their causes and the class affected. The statistician comments with much force on the great frequency of accidents to employees. The total number of railway employees in the year under consideration was 749,301, hence one death occurred for every 300 men employed and one injury for every 33 men employed. Corresponding figures for the previous year give one killed for every 357 men employed and one injured for every 35 men employed, thus showing an increase in the danger of railroad employment. Trainmen are far more liable to accident than other classes of employees. While they form but 20% of the total number, 58% of the casualties occur in their ranks. An engineer, brakeman, or conductor, working steadily eight hours per day, has one chance in 12 of being injured and one in 105 of being killed during a year's work. As this includes both freight and passenger service, the dangers attending freight train work must be considerably greater even than this.

Table XIII.—Comparative Danger of Railway Travel and Railway Service in Different Sections of the United States:

	States east of Ill. and north of Ohio and Potomac Rivers.	States south of Ohio and Potomac and east of Miss. Rivers.	States west of Ind. and lower Miss. River.	United States.
Employees:				
No. of for one killed.	290	241	364	306
" " " injured.	36	22	36	33
Trainmen:				
No. of for one killed.	107	65	129	105
" " " injured.	12	7	14	12
Passengers:	(1 = 1,000)	(1 = 1,000)	(1 = 1,000)	(1 = 1,000)
No. carried for one killed	2,520	839	976	1,728
No. carried 1 mile for one killed	47,037	31,022	37,867	41,426
No. carried for one injured	348	78	103	203
No. carried 1 mile for one injured	6,504	2,901	4,000	4,886
Percentage of Employees Killed through Various Causes:				
Collisions	9.0	14.3	8.2	9.6
Derailments	2.4	10.5	10.1	6.1
Other tr'n accidents	4.3	6.9	8.2	6.0
Total tr'n accidents.	15.7	31.7	26.5	21.7
Coupling and unc'pl'g	14.1	14.3	17.0	15.1
Falls fr'm tr'ns & eng's	23.3	21.0	23.1	22.9
Overhead obstr'ctions	3.6	6.1	2.4	3.6
Other causes	43.3	26.9	30.9	36.8
Percentage of Employees Injured through Various Causes:				
Collisions	3.8	6.1	4.9	4.6
Derailments	1.2	5.8	4.5	3.2
Other tr'n accidents	3.5	5.5	3.0	3.7
Total tr'n accidents.	8.5	17.4	12.4	11.5
Coupling and unc'pl'g	39.3	33.7	30.0	35.9
Falls fr'm tr'ns & eng's	9.7	11.5	11.1	10.6
Overhead obstr'ctions	1.6	1.9	1.4	1.5
Other causes	40.8	35.6	45.1	41.3

As stated last week, the report presents the first figures ever collected showing the comparative safety of railway travel and employment in different sections of the country. Table XIII. gives those of most importance. It is apparent from this that passenger travel is safest in the East and most dangerous in the South. The difference, however, is probably less than is indicated by the figures given, since the comparison is made on the basis of passengers carried. While this is a correct basis for accidents in getting on or off trains, it is somewhat misleading as regards train accidents. A Southern road running, short, poorly filled passenger trains, might have no more accidents in proportion to train mileage than a road with such a heavy passenger traffic as the Old Colony, and still would show a much larger number of injuries and fatalities in proportion to the number of passengers carried. It is to be hoped that in future reports a compilation may be made of freight and passenger train accidents in proportion to train mileage of each class in the different sections of the country.

It is worth notice that the Western railways show a smaller proportion of employees killed than even the Eastern roads, and no greater proportion of employees injured. The reason for this is not apparent, for train accidents are considerably more frequent there than in the East, according to the statistics for trainmen and for passengers, and the percentage statement of accidents due to various causes. The gain over the East is in the class of accidents for which no cause is assigned.

The figures giving the percentage of employees killed in collisions indicate pretty plainly the need of a better system of train movement on the roads of heavy traffic in the East, where the proportion of fatalities from this cause is even greater than on the roads west of the Mississippi. Still more evident is the lesson taught by the injuries and fatalilites due to derailments, which are three or four times as frequent in the South and West as in the East. The statistician ascribes this "to poorer roadbeds and an inferior degree of technical management.' Probably no one will question that he is correct as regards the former cause, whatever may be said concerning the latter.

THE CONSTRUCTION OF LOCOMOTIVE BOILERS.

At the last meeting of the New England Railroad Club papers on the above topic were read by Mr. J. L. Speirs, of the Rhode Island Locomotive Works, and Mr. F. W. Dean, M. Am. Soc. M. E. We shall publish Mr. Dean's paper in a later issue. Mr. Speirs' paper was substantially as follows:

The principal features of a good locomotive boiler should be: (1) Grate and heating surface sufficient to make surplus steam with ordinary coal and firing when engine is working hardest; (2) greatest simplicity consistent with strength; (3) fewest possible number of separate pieces; (4) best material and thickness proportioned to give all parts an equal factor of safety; (5) largest practicable air space in grate; (6) largest space for combustion in firebox consistent with ample circulation space; (7) braces used where needed and nowhere else.

Material.—The tendency of late years is to use a softer steel than formerly. This is in the right direction and a specification for 50,000 to 55,000 lbs. tensile strength would be even better than the 50,000 to 60,000 lbs. commonly used. The softest steel endures best the strains of flanging, punching and bending, and will be under less initial strain in the completed structure. If the use of steel so soft as this lowers too much the factor of safety, increase the thickness $\frac{1}{16}$ in. and put stays a little closer together.

Firebox.—If best steel cannot be afforded for the whole boiler, use it at least for the firebox. Water space around the firebox should be 3 to 3½ ins. at the bottom, increasing to 4½ or 5 ins. at the top. Keep the barrel of the boiler high above the rails and so secure a good length of water leg. There is no good reason why the crown should not be carried well up, leaving only sufficient space above crown bars to get in drypipe and rigging and admit of a good job on backhead stays. Making the flat sides of the leg overhang the fire is often spoken of but seldom put in practice. It should be carried out in every boiler built, to the extent of ⅛ in. to 1 in. It is advisable to secure all the firebox heating surface possible. Various authorities give the ratio of efficiency of tube heating surface to firebox heating surface at 3 to 1 to 10 to 4. The last is probably nearest to the truth in practice, where part of the tubes are more or less choked with cinders. Good circulation promotes economy and makes a boiler steam freely. Why not adopt some mechanical means for forcing circulation in the legs where evaporation is so rapid? Better circulation, moreover, means less strain due to inequal expansion.

Water tables and kindred devices have so far been failures, largely on account of defective supply of water for circulation, which reduces the evaporative performances and increases the bill for repairs. So far nothing has surpassed the water tube for increasing heating surface as well as for supporting that admirable contrivance for promoting combustion, the brick arch.

Tubes.—Tubes should be so spaced that there will be a clear space between the vertical rows. Yet within a short time I have seen drawings from a large New England road showing tubes spaced horizontally to leave a ⅝-in. bridge, and the tubes on the next lower row were placed directly underneath these spaces.

Shell.—In making the shell, use the largest plates possible and save expense and uncertainty of circumferential joints. Plates can now be procured of the principal makers up to 11 ins. wide with a length of 230 ins., and up to 120 ins. wide for 200 in. lengths. The outside shell of firebox should be made of one plate wherever possible. Other advantages of wide plates are the facility with which lagging is applied, and the avoidance of difficulty in spacing rivets of the longitudinal seam. In wagon top boilers having 10 ins. or more difference in diameter between the the shell and the back end, it is wasteful to use plates of the same thickness for wagon top and for shell.

Radial Stay Boilers.—The present tendency is to discontinue the use of the old crowbar boiler and substitute the radial stay type. The use of radial stays in place of crownbars on a boiler for an 18×24-in. engine does away with 960 pieces, including crownbars, washers, bolts, nuts, links, braces, crowfeet, lugs, pins, rivets, etc. The weight of these pieces is 3,585 lbs., against 1,054 lbs. for the parts which take their place in radial stayed boilers. The greatest objection to the radial stay is the angle at which three or four rows of stays enter the outer sheet, which makes heading over the end a difficult matter, as the blow from the hammer does not fall in line with the axis of the bolt. Care and skill, however, will produce a satisfactory job. It is important to have two rows of stays each side of the center on top made with a head and screwed in from inside the box. These are chiefly put in as a safety measure in case of low water. The solid heads are preferable to nuts because of their greater holding power and the facility with which a good fit in the crownsheet may be secured. The thread on the headed bolt is cut close under the head in a lathe and then sized with a slightly tapered sizer so that a steamtight fit is secured in the hole. Lack of tools adapted to its construction is the one thing more than any other which has kept the screwed stay boiler in the background. Any little difficulty in building it is more than compensated for by the accessibility of all parts for cleaning and inspection, and its free steam space, with the dome well forward of the point of greatest agitation, securing thus dry steam.

A crownbar boiler in the space 7 ins. above the crown has space which would otherwise hold 53 gallons of water occupied by crownbars and other obstructions, or 39% of the total. The remaining space is so cut up that with a hot fire the water is tortured to froth in its effort to send steam to the space above. The radial stays, on the other hand, displaced but 4 gallons of water. There is a still greater difference in water capacity of the two boilers due to the different form of the crownsheet. The crownbar boiler for an 18 × 24-in. engine, before referred to, contains 1,048 gallons of water, when filled to second gage. The radial stay boiler under the same conditions holds 1,427 gallons, or 379 more.

Too much importance cannot be attached to this feature, as the extra amount of highly heated water ready to flash into steam will, when increased power is required, act as a reserved force. Further, suddenly starting the injector full force will not alter the temperature of the water to the same degree, the quantity in the boiler being greater: neither will the water level fluctuate so rapidly, as the whole body of water above the crown is practically solid. It is true that this increased water space is accompanied by a decrease in the volume of the firebox of 5½ cu. ft., with a loss of 11 sq. ft. of heating surface in the firebox out of a total of 141. A large part of this loss must be made up in the greater efficiency of the surface remaining, as a curved surface or crown is presented to the fire 66 ins. in breadth, against 56 ins. in the crownbar boiler.

Belpaire Boiler.—The Belpaire boiler is a favorite with many master mechanics on account of its free steaming qualities. It is often commended on account of its free crown surface and accessibility for cleaning; but those who say this can never have made an inspection of a Belpaire firebox from inside the shell. The vertical and horizontal stays are so numerous that it would be impossible to use a scraper, and even a stream of water would spend a large part of its force against the stays. In building a Belpaire boiler the four central rows of crownstays should be treated as above recommended for radial stay boilers.

Flanging.—Flanging is the hardest and most difficult operation in the construction of a locomotive boiler; but upon the manner in which it is done the boiler's durability largely depends. Plates now average ½-in. in thickness, and 5/8-in. are not uncommon. Soon, I feel confident, we shall be building boilers for compounds to carry a pressure of 250 lbs. and made of ¾-in. plate. Even with present thicknesses the use of a flanging press is almost a necessity and its general use will make a new era in boiler construction. Such flanges as the backhead and connection between shell and firebox of the Belpaire boiler will then have no terrors.

The one reason more than any other which has operated to prevent the Strong boiler from coming into extended use is the difficulty of properly shaping and flanging the plates connecting the shell and the twin fireboxes. I think I am justified in saying that there is so much to be commended in Mr. Strong's boiler (an almost entire absence of flat surfaces, braces and stays) that many would have given it a trial but for the increased cost due to lack of facilities for doing the work. From a press, the work would come to the layer out and fitter up of a uniform size and shape, very much simplifying the work of both. The plates would be free from local strains set up by local heating and working.

There is no reason why all straight boilers of a certain diameter should not have height of crown above boiler center and shape of box fixed. The same applies to wagon top or Belpaire boilers, making the wagon tops in two classes, 6-in. and 10-in. rise (I am presuming that all are now converted to round backheads), the length of leg would make no material difference. The subject is one worthy the attention of the Master Mechanics' Association.

Riveting.—Almost all the holes and the shapes of all the plates can be laid out by a competent man while the plates are flat. If part of this work is left to be marked by the various fitters as the work progresses, the result is chaos—no two boilers alike.

With the thickness of plate now common, all longitudinal seams should be butt joints with a lap joint, the thicker the plate the greater the departure from a true circle at the joint. The heavy internal pressure now carried tends to correct this departure from a circular form and thus the plate is bent back and forth with changes in pressure. This is the cause of many leaky joints and rivets. The welt, where used, has been a more or less efficient safeguard against grooving; still it is not the correct thing, and with a plate ⅝ in. or thicker, nothing but a butt joint seam, with inside and outside covering strips should be used. By using a wider covering strip inside than out, placing six rows of rivets in the inner cover and four in the outer, we can get nearer the full strength of the plate than by any method save welding, which is not yet common in this country. By properly proportioning rivet and plate area, a joint may be made to have 85% of the strength of the solid plate. Circumferential seams should be double riveted, not so much as a measure of strength to resist pressure, but to better resist the strains and shocks received by engines in service and the tendency to grooving along the bottom, due to differences in temperature between top and bottom of shell.

Every rivet possible should be driven by power. It is becoming possible to thus drive a greater proportion owing to the improvement in machinery for the purpose; the latest style riveters having a greater reach and scope. There are several of the smaller portable machines for special parts. I would especially recommend the use of one of these for closing the rivets in the firebox ring. By using such an appliance, a rivet ¾ in. longer than could be closed by hand may be driven, and will leave no larger head, the extra length having been forced into the long hole, completely filling it. The head is also changed in shape by the holding-on die, which forces part of the metal from the head into the hole, making both ends equally to be relied on for tightness.

Were such a machine in general use, leaky mud rings would be a thing of the past, except perhaps in the inside corners. The remedy for the gradual wasting away of these is not to be sought in riveting but rather in the increased flexibility of parts at bottom—a remedy difficult of application, for we cannot work outward. By raising the grate a few inches and carrying the bottoms of the four plates forming the box inward until a 6-in. water space was obtained, we could insert a ring of pressed boiler steel with flanges pointing downward. Whether this construction and width of ring would give flexibility sufficient to allow the firebox to move downward and horizontally enough to greatly help staybolts, rivets and corners, I am not prepared to say, nor do I know that it would in the end pay for the extra expense and trouble; it only occurred to me as a possible remedy.

Staybolts.—I am convinced if our fireboxes were free to expand from the center of the side-sheet in all directions, we would have little trouble from broken staybolts. Higher pressures may be responsible for part of the trouble lately experienced, but if investigated thoroughly, I think thicker plates and higher and longer boxes, will be found to be the chief cause. With the thicker plate now in use for the outside covering, the staybolt is held so firmly and the plate is so stiff that there can be little or no movement, consequently as the box expands upward and lengthwise under the intense heat to which it is subjected, the whole bending stress comes on a point just inside the outer sheet, in which they are so rigidly held. Most of you will remember that when 5/16-in. and ⅜-in. plates were used, it was a very common thing to see the casing of a box flake away inside around the stay-bolt holes at just the same locations as are now giving the most trouble, top rows and end vertical rows. Sometimes while the sheet would be flaked away the bolt would be perfect. At other times it also would be reduced in size at the point of contact and part way into the plate. I have seen sheets countersunk in this manner nearly through. This occurred because the sheet compared with the bolt was comparatively thin and flexible; the bolt sprung the plate, and also worked in the hole.

I would like to bring up the question of how a radial stayed boiler acts in regard to breaking stays. It looks as if there should be less trouble, as the height in a boiler of the same size to the last short bolt is some 10 ins. less.

Drilling bolts tell-tale will indicate when a bolt has broken, but it in no way acts as a preventive. Some remedy there must be for the trouble, and it should be sought. A larger bolt of say 1⅛ in. or 1¼ in. diam. would make the ratio between plate and bolt somewhat the same as when the bolts were ⅞ in. and plate 7/16 in. or ½ in. Even if this worked as above described, I do not think it right to cure one evil and cause as great a one. I would not sacrifice the plate to save the bolt.

Turning bolts down to the bottom of the thread, leaving but 2 ins. or so of thread at each end, is by no means a new thing in boiler work, but has been generally used only on long stays to save time in cutting and running them in. I would like to see the experiment tried of using 1-in. bolts turned down to ⅞-in. at a point, which when in place would be one-third of the width of the water space from the inside sheet, then taper out each way to full size at a point ¼-in. or ½-in. from the inner face of both sheets. Perhaps to make such a test of value, it would be well to put in every other bolt made in this manner and the others of full section. The length of life and usefulness of each could then be tested under the same conditions.

Bracing.—For the support of the back head above crown and front head above tubes, the simplest brace is the long rod from end to end. Where such a brace is supported at about the middle, it is an efficient stay. Where not so supported it will give trouble by leaking or breaking at the ends. A 17-ft. or 18-ft. rod will vibrate badly when the engine is in motion.

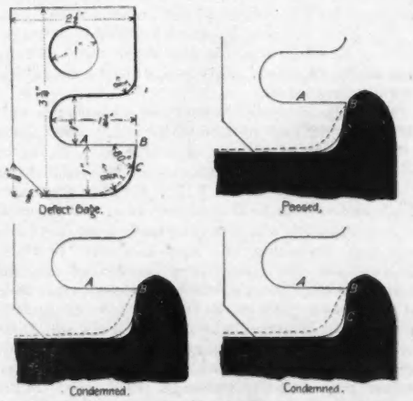
A liner ⅝ in. or ¼-in thick on the inner side of backhead, extending down to take the top row of staybolts, stiffens that part and better distributes the strain on the staying. Some oppose the staying of backhead to shell or connection, on the ground that by so doing these parts are subjected to great strain, the angle of the stays causing a tendency to flatten the shell, and again that the extra holes for attachment will unduly weaken the plate. As a matter of fact, the braces from backhead when carried to shell have a very slight inclination; most of them being in a direct line, the plate is amply able to resist any little strain set up, aided as it is by the pressure within. In regard to the holes for the attachment of braces, as the measure of the strength of the shell is the resistance of the longitudinal seam to tearing apart under pressure, the holes for two or even three braces in a line across an ordinary shell plate are not going to leave the plate as weak as at the joint.

If in putting stays from crown-bars to roof, two to each bar, placed from 6 ins. to 8 ins. each side of center, are not thought sufficient, it is better to increase the size of both stays and crown-bars, rather than put on four, as is often done. Where crown-bars are used they should be of ample strength to sustain their load without aid; the sling stays being applied as a measure of safety in case of overheating.

Testing.—Locomotive boilers are not usually tested high enough to warrant carrying such pressure as 160 lbs. About all insurance companies make it a rule for the test pressure to add 50% to the pressure allowed. The practice I think is a good one. It is better to make the test for safety with warm water. The test for tightness should be made later with a steam pressure of about 1¼ times the working pressure. A boiler made tightly under a water pressure is seldom perfectly tight under even a less pressure of steam, and the same would be true of steam first and water afterward. It is better to make the final test as nearly as possible under the working conditions.

SUGGESTED CHANGE IN STANDARD WHEEL GAGE.

At the coming meeting at the Central Railway Club, to be held at Buffalo, N. Y., Jan. 27, 1892, the committee continued from the last meeting, for the purpose of submitting suggestions for any further improvement in the present M. C. B. standard wheel defect gage, will submit a proposal for the change in the standard wheel gage shown in the accompanying cut. Instead of rounding off the corner with a 1-in. radius curve, as shown by dotted line, the committee will propose that, starting from B with an angle of 80°, and running a tangent to point C (giving the straight line BC), a curve of ⅝-in.



Proposed Changes in M. C. B. Standard Wheel Defect Gage.

radius be struck. The committee will also recommend that the radius E be increased $\frac{1}{16}$ in. to $\frac{5}{8}$ in.

In applying this gage, when the point B strike the flange, the wheel must be condemned; but if the gage strikes at point C, leaving an opening at point B, the wheel will be considered safe to run, all as shown on the accompanying sketches. The effect of the change to a $\frac{5}{8}$-in. radius is to pass certain wheels which would otherwise be condemned (as would all the three wheels sketched, under the present rules); but the effect of the change from $\frac{1}{16}$-ins to $\frac{5}{8}$-in. radius is to reject wheels because of their flanges a little sooner than they otherwise would be be rejected.

The great Aransas Pass strike is over, its back having been broken by the refusal of other labor organizations to "legalize" it, and thus cause the refusal of all cars from the road. While we do not attempt to keep track or make record of labor troubles of this kind, the general fact that the relations of employers and employed seem to be becoming less strained instead of more so, and strikes less lawless instead of more so, is evident by comparisons of the last eight or ten years. There may be a change for the worse, but so far the outlook is encouraging.

Fifty new locomotives are contracted for by the Baltimore & Ohio Ry. Co., to be used on the heavy grades between Wheeling and Harper's Ferry. The same news item says that the B. & O. Co. will begin work in a few days on double tracking the 100 miles of line between Wheeling and Grafton, W. Va.

Two twin screw passenger steamers are to be built at Rondout, N.Y., for the Albany & Troy Steamboat Co. They will be 90 ft long, 23 ft. beam, 6 ft. depth of hold and will each be fitted with two compound engines. It is somewhat strange that screw propellers and modern types of high pressure engines have not been introduced to a greater extent yet for river steamers on the lines running from New York. The majority of these steamers, including several of the newest ones, have the old-fashioned low pressure engines, with walking beams and side wheels. The "Connecticut," of one of the lines running on Long Island Sound, has oscillating engines, driving side wheels, but the use of the modern marine engine for passenger steamers on these island waters is yet very limited, although light draft screw steamers have been used elsewhere with success.

The new water supply for Berlin, from Lake Mueggel, was commenced in June, 1890, and will be completed in 1893. These works are to furnish 22,000,000 gallons daily to begin with, but this will be doubled when the Friedrichshagen works are finished. The water is passed from the lake through filter beds of sand and gravel and is then pumped 131 ft. to a reservoir.

The Newfoundland census shows an increase of only 4,100 or 2½% over the 1884 population of 197,900, the previous decade (1874-84) having shown an increase of 22¼%. The result has naturally been a great disappointment, indicating a large emigration to the United States. Small as is Newfoundland's increase, however, it is about twice as great as that of the maritime provinces of the Dominion. Even the chief city, St. John's, shows a decrease of over 2,000, its population in 1882 having been about 30,000.

The multiple speed and traction railway, or movable sidewalk, that is to be put in operation during the Columbian Exposition in Chicago, is now on exhibition in Room 62, 140 Nassau St., this city. Mr. Max E. Schmidt, C. E., is the Secretary of the company and the model is in charge of Mr. N. H. Furness.

Hydraulic buffer stops were recently tested at the Cheshire Lines station, Liverpool, England. A train weighing 130 tons and consisting of an engine and 8 empty cars was run against one pair of the buffers at speeds of 3, 6 and 8 miles per hour, and, according to report, was in each case stopped without injury in the 5 ft. travel of the pistons. A second pair, however, gave way under the force of the blow at a speed of 8 miles per hour.

The self-purification of rivers, is ascribed by Prof. von Pettenkofer, says the "Centralblatt der Bauverwaltung," principally to the presence of vegetable life in rivers, though until recently the settling of heavier parts, and the absorption of organic matter by the oxygen of the water were thought to be the cause of it. According to observations by the botanist von Naegeli, the existing algæ, diatoms, etc., will absorb the organic parts as nourishment, while the water-bacteria, which are even found in pure water, will destroy the floating pernicious bacteria. If, however, the organic matter should enter the river entirely undissolved, the algæ become glutted and will perish. Refuse from factories, of an acid or poisonous nature, will also extinguish the vegetable life in a river. Organic matter in bulk is also harmful. Therefore gratings should be affixed to the entrance of sewers into the stream.

For these reasons in a river with a slow current, which cannot dilute the floating organic parts, or where the vegetable life is already diminished by noxious refuse from factories, undissolved sewage should not be admitted.

Cement pipes, with imbedded wire netting, are being made by a newly invented machine, for which process the Monier Co., of Berlin, holds letters patent for Germany. The "Centralblatt der Bauverwaltung" says that with this machine comparatively thin walled cement pipes are manufactured, which, despite their thinness and light weight, show a high resistance against external and internal pressure, so that they are well adapted for water conduits. In the manufacture of these pipes Portland cement of uniform density is used. Up to about 20 ins. diam. the pipes receive one layer of wire netting, while in pipes of greater diameter two thicknesses are used. All pipes, even sewer pipes of egg-shaped section, are manufactured.

Bridge work is advertised for by the Board of Administration of Egyptian Railways, and proposals will be received by the Board at Cairo, Egypt, until March 31. The work includes a double track bridge over the Nile at Benha, the addition of a second track to the Kafr Gaiat bridge over the Nile, and the alteration of two canal bridges. Specifications, with conditions and descriptions of the work, can be obtained from Lt.-Col. Western, Inspecting Engineer, Broadway Chambers, London, England.

Another cotton picking machine of much promise is announced, now constructed by the Cotton Harvester Manufacturing Co., of Chicago. Two years ago Messrs. Florsheim, of Chicago, and T. H. Ball, of Aurora, Ill., obtained control of a crude cotton picker, invented by a Southern man named Todd. They began a series of experiments for the perfection of this invention. Last year a machine was made in Aurora by the Gardiner Sewing Machine Co. and taken to Mississippi, tested in a cotton-field, and then still further perfected. This winter 12 more machines will be made.

The machine consists of two upright revolving cylinders which "straddle" the cotton row. From the cylinders reach out rapidly revolving fingers, armed with fine wire brushes. When the machine is driven down a cotton row the ripe cotton is wound out of the balls and carried into a receiver. The plant and unripened balls are not injured. The machine will do the work of 70 negroes, it is claimed.

Paris passenger traffic in 1889 is thus given in the "Album of Graphical Statistics," lately issued by the French Minister of Public Works:

Intr mural Lines:	Lengths. Miles.	Receipts.	No. of passengers.
Omnibus	141.4	$4,600,199	119,794,600
Tramways	63.9	3,285,673	88,63[illegible],090
Steamboats	7.5	not given.	28,294,000
City railways	24.2	1,298,267	37,396,000
Extra-mural:			
Tramways	101.7	1,728,513	60,140,000
Steamboats	8.0	not given.	4,592,000
Totals	346.7		338,846,000

The total number of passengers carried on the French railway systems in 1889, outside of Paris, was 241,165,000.

CONSTRUCTION NEWS.

RAILWAYS.

East of Chicago.—Existing Roads.

ORFORD MOUNTAIN.—This railway, which has just been completed from Eastman to Lawrenceville, P. Q., 10 miles, will be extended to Kingsley, P. Q., early next spring.

CLEVELAND, CINCINNATI, CHICAGO & ST. LOUIS.—There is some probability that this company will begin work on its proposed line to connect the Peoria and Whitewater divisions during the coming spring. Several surveys have been made and press reports state that everything is ready for the early commencement of work. The line will be about 16 miles long and will run from Hagerstown or Cambridge City to Indianapolis, Ind.

PENNSYLVANIA.—Work has been begun on the extension of the Chestnut Hill Branch to Fort Washington, Pa., on the Trenton cut-off.——The grading on the extension of the Cambria & Clearfield R. R. from Kaylor's Station has been completed and track has been laid as far as Buck's Mills.

PHILADELPHIA & READING.—The engineers are making good progress on the survey of the proposed line from Pleasantville to Woodmancie Station, N. J., 30 miles, and it is stated that the right of way is nearly all secured.

LANCASTER & HAMDEN.—It is reported that this company has marketed $3,000,000 of bonds the proceeds to be used in completing its proposed railway. The road as projected is to run from Columbus and Hadley Junction to the Ohio River, 160 miles, with a branch to Wellston. About 12 miles of the line are already built.

CANADIAN PACIFIC.—A press dispatch says: A scheme of the Canadian Pacific Ry. to build a branch along the Niagara River, on the Canadian side, at Niagara Falls, and cut off the Michigan Central, has come to light. A dispatch from Toronto announces that E. B. Osler, H. C. Hammond, of Toronto, Ont.; Wm. Henric, of Hamilton, Ont., and R. B. Argus, of Montreal, P. Q., have asked for a charter from the Ontario Legislature for the Nirgara Falls Park & Queenstown Electric Ry. & Steamboat Co. The line proposed is to run from Fort Erie, opposite Buffalo, to Queenstown, opposite Lewiston, and through the Queen Victoria Niagara Falls Park. The charter, however, permits the company to run its road by steam, also to build hotels, inclined railway elevators, wharves, and to run a line of steamers. It has been pretty well established that this is simply a blind, and that the men who have applied for the charter are Canadian Pacific directors and interested in the road. The rumor is that this will be the main line of the road for passenger traffic, connecting at Queenstown, probably, with a line from Woodstock, running along the bank and crossing a bridge to the Falls. The road contemplates an extensive system of boats both above and below the Falls, the latter running to Toronto.

BUFFALO, ROCHESTER & PITTSBURG.—The contract for the masonry on the Johnsonburg & Bradford R. R. has been let to Evans & Delaney, of Bradford, Pa. The contractors' plant is rapidly arriving and work will be in full progress in a few days.

ADIRONDACK & ST. LAWRENCE.—This company has secured the necessary right of way across the State lands in Franklin Co., N. Y., and is now at work on the line. This will make the line far more direct than would otherwise be possible.

SALEM & WASHINGTONVILLE.—The grading on this short railway from Salem to Washingtonville, O., is nearly completed and tracklaying will begin in a short time. The road will probably be opened for traffic by March, 1892.

CLEVELAND & CANTON.—A report is in circulation that the company will extend its line from Sherrodsville, O., east parallel to the Wheeling & Lake Erie R. R. to Wheeling, W. Va., about 50 miles. Surveys are reported in progress.

BALTIMORE & OHIO.—This company has marketed $5,000,000 of bonds, the proceeds to be used in improvements of tracks, stations and rolling stock and the extension of the Chicago terminals.——It is stated that work will be soon begun on an extension from Fairview Station, near Chester, Pa., northwest to Media, Pa., and thence to Gradyville, Edgemont and Middleton. It is reported that arrangements are being made to build a road from Leiperville Quarries, via Eddystone to connect with the main line at Chester, Pa.——An effort is being made to induce this company to build the old Ohio & Baltimore Short Line R. R., projected to run from Zediker Station, near Washington, Pa., to the coke regions. About $1,5[illegible]0,000 was expended in grading this line some years ago, and then the work was abandoned. It is stated that the old roadbed can be put in good condition at small expense.

Projects and Surveys.

BANGOR & AROOSTOOK.—An important step has been taken toward the construction of this Maine Railway by the subscription of $200,000 to the preferred capital stock of the company. The surveys are completed for the main line, and work is well along on the branches. It is hoped to begin construction in the spring. A. A. Burleigh, President, Houlton, Me.

PITTSBURG, CANNONSBURG & STATE LINE.—It is reported that President A. E. Succop, Pittsburg, Pa., is closing up the right of way contracts, and will have the section from Pittsburg, Pa., to Wellsburg, W. Va., under contract early in the spring.

TUSCARAWAS VALLEY.—A number of the large coal mine owners in the Tuscarawas Valley are taking steps to build a railway from Justus, O., at the junction of the Cleveland, Canton & Southern and the Cleveland, Lorain, & Wheeling Railways, up the Pigeon Run Valley, over the abandoned survey of the Wheeling & Lake Erie R. R., to Dalton, O., 11 miles.

Southern.—Existing Roads.

EAST TENNESSEE, VIRGINIA & GEORGIA.—This company has contracted for 7,000 tons of 75-lb. steel rails with which to relay its line from Oakdale to Chattanooga, Tenn.

ARCADIA, GULF COAST & LAKELAND.—This company proposes to have the 13 mile section from Braidentown to Sarasota, Fla., recently put under construction, completed by Feb. 22.

MACON & BIRMINGHAM.—The receiver of this road will issue $30,000 of receiver's certificates, the proceeds to be used in further improving and equipping the road.

ALABAMA MIDLAND.—The contract for grading the first 60-mile section of the proposed extension from Luverne, Ala., south, is reported to have been let to Geo. Peterson, of Luverne, Ala.

PENNSYLVANIA.—It is stated that this company has made a proposition to the projectors of the West Virginia & Pennsylvania R.R. to build the line from Waynesburg, Pa., to Clarksburg, W. Va., if the right of way be granted free. About nine-tenths of the right of way has been secured, and work, it is stated, will begin early in the spring.

BALTIMORE & OHIO.—It is reported that this company has decided to commence work early this coming spring on an extension of the Valley Branch from Lexington to Roanoke, Va.

ATLANTIC COAST LINE.—Tracklaying on the branch from Fayetteville to Rowland, N. C., has reached a point 27 miles south of Fayetteville, about 6 miles having been laid since Jan. 1, 1892.

Projects and Surveys.

POTTS VALLEY R. R. & IRON CO.—A bill has been introduced into the Virginia Legislature to incorporate this company to build a railway from the Chesapeake & Ohio Ry., at or near Covington, Va., to the Norfolk & Western R. R., at or near Big Stoney Creek.

CHARLESTON, CLENDENNIN & SOUTHERN.—Proposals will be received for constructing the first 20-mile section of this railway until Feb. 20, 1892. Sec., John B. Floyd, Charleston, W. Va.

OCALA, ALTOONA, DE LAND & ATLANTIC.—Frank J. Hirson, Altoona, Fla., and others are promoting a project to build a railway by this name.

CHRISTIANSBURG BELT.—It is stated that the contract for building the three-mile belt railway at Christiansburg, Va., has been awarded to Rogers & O'Brien, Christiansburg, Va.

LAWRENCE & GULF.—It is announced that work will begin at once on this proposed railway from Bula to Bronson, Fla., 32 miles. Chas. P. Turner, Supt., Atlanta, Ga.

VIRGINIA.—The Chesapeake & West Virginia R. R. Co. has applied to the legislature for a charter. The road is to extend from some point in Highland, Augusta or Rockingham Co. to some point on the Potomac or Rappahannock rivers.——A bill has been introduced in the legislature incorporating the Potomac & Great Falls R. R. Co. with R. W. Moore, B. F. Mackall, S. R. Donohue and others as incorporators. The company proposes to construct a railroad from Great Falls to a point on the Potomac River between Great Falls Church and Alexandria. The capital stock is $500,000.——It is stated that N. R. Stanger, of Blacksburg, Va.; J. W. Mar

shall, of New Castle; A. Robinson, of Radford; Decatur Axtell, of Richmond, and others will petition the legislature for a charter for a company to build a railway from a point on the Chesapeake & Ohio Ry. at or near Covington to a point on the Norfolk & Western R. R. at or near Radford.—The Roanoke & New Castle Ry. & Mining Co. has applied to the legislature for a charter, with A. Z. Koiner, R. H. Woodrum, J. T. Engleby, of Salem, and others as corporators, to build a railroad from Roanoke to connect with any road in Craig Co., or extend to the Kentucky or Tennessee lines. The capital stock is $5,000,000.—The Salem & Southern R. R. Co. has applied to the legislature for a charter to build a railway from some point on the Roanoke & Southern R. R. to Salem. The Salem & Craig Railway & Mining Co. has also applied for a charter to build a railroad from Salem to some point in Craig Co.

HINTON & NEW RIVER.—The organization of this company has been completed, and surveys are to be commenced at once. The road is projected to run from Hinton, W. Va., to the mouth of East River, in Mercer Co.

Northwest.—Existing Roads.

CHICAGO & NORTHWESTERN.—A rumor is in circulation that the Fremont, Elkhorn & Missouri Valley R. R. will be extended from Ft. Casper, Wyo., to Ogden, Utah, about 400 miles. This move is stated to be made in competition to the reported scheme to extend the Union Pacific Ry. to the Pacific Coast. There is little likelihood of either line being built this year.

DULUTH & WINNIPEG.—It was decided at the recent annual meeting of this company to push the main line of this road directly west from Grand Rapids, Minn., on a line about midway between the Northern Pacific R. R. and the Great Northern Ry. The proposed line to Winnipeg, Man., will branch off the main line at or near Foster, Minn.

CHICAGO, MILWAUKEE & ST. PAUL.—It is stated that steps are being taken toward the construction of a line from Sioux Falls to Madison, S. Dak.

DULUTH & IRON RANGE.—New iron ore docks will be constructed at Two Harbors, Minn., at a cost of $75,000.

MINNEAPOLIS, ST. PAUL & SAULT STE. MARIE.—It is stated that the right of way is being secured north of Valley City, N. Dak., and that the indications are that the line constructed from Hankinson to Valley City, during 1891, will be extended north toward the International line.

WINONA & SOUTHWESTERN.—A dispatch from Fort Dodge, Ia., says: "Recent developments indicate that the Winona & Southwestern has bought, or is about to buy, the Mason City & Fort Dodge R. R. At a meeting of the Business Men's Association, Jan. 16, a communication was read from Secy. Simpson, asking what inducements Fort Dodge had to offer. Mr. Simpson visited the city quietly, and held a two days' consultation with John F. Duncombe. O. H. Manning, a Chicago railway attorney, is authority for the statement that the deal has already been made, and that the road will go through to Omaha by way of Jefferson, Coon Rapids and Audubon."

Projects and Surveys.

TERRE HAUTE, SAYLOR SPRINGS & CHESTER.—Incorporated in Illinois to build a railway from a point on the eastern boundary of Clark Co., Ill., via Saylor Springs to Chester, Randolph Co., Ill. It is stated that a portion of the right of way has been secured and that work will commence at an early date. Among the incorporators are Lewis A. Barnes, Thos. Hanifant and Warren C. Rhodes.

TEXAS & BISMARCK.—Chartered in North Dakota to build a railway from Galveston, Tex., to Bismarck, N. Dak. The enterprise is said to be backed by "prominent moneyed men."

WOLSELY & FORT QU'APPELLE.—Notice is given that application will be made at the next session of parliament to incorporate the Wolseley & Fort Qu'Appelle Ry. Co., with power to construct and operate a line of railway from a point on the line of the Canadian Pacific Ry., at or near Wolseley, in the N. W. T., thence to Qu'Appelle Valley via Wolf Creek, thence up the Qu'Appelle Valley to Fort Qu'Appelle, a distance of about 40 miles.

CHICAGO & GREAT WESTERN.—Chartered in Illinois to build a railway from a point on the boundary line of the State of Illinois and Indiana to a junction with the Minnesota & Northwestern R. R., thence to a point on the shore of Lake Michigan, with a branch to a point on the shore of Lake Michigan near the mouth of the Calumet River, all in Cook Co., Ill. The capital stock is $2,000,000. The incorporators are S. C. Stickney, H. A. Gardner, and others. The Chicago "Journal" says: "The matter is being kept quiet, and little information can be obtained as to the objects of this corporation. There seems to be a general understanding, however, that its scheme is similar to that of the Great Northern Ry. Co. It is expected that it will absorb and come into control of the Chicago, St. Paul & Kansas City property. Of course it is proposed to secure bonds on which to raise money and build up a great system of railroad. Just what the plans for building are will not be known until Mr. Stickney returns from New York."

Southwest.—Existing Roads.

CHICAGO, BURLINGTON & QUINCY.—A press dispatch from St. Louis, Mo., says: Work has been begun on the Madison & St. Clair Belt Line, a road which is to give the Burlington connection with East St. Louis and at the same time enable it to enter St. Louis over its own roads and bridges. At present the C., B. & Q. trains from the east come in over the Eads Bridge, and those from the west over the Wabash tracks from St. Peter's, Mo. The belt line named has a charter, with all plans properly approved, for a bridge over the Mississippi at Alton. With this bridge the belt line is to connect East St. Louis. The C., B. & Q. system from the east will cross over the Alton bridge, and by means of the new road enter St. Louis from the north. From St. Peter's, Mo., a new road is to be built to connect with the Alton line, crossing the Missouri River on a bridge to be erected at Bellefontaine Bluff. Work on both these bridges is to be begun early in the spring. All preliminary work has been done under the guise of the belt line on the east side of the Mississippi and the St. Louis, Keokuk & Northwestern on the west side. Nevertheless, it is certain that the C., B. & Q. is really at the bottom of it all, in spite of President Perkins' denials, as it owns the Keokuk line and its owners are backing the belt line. As an evidence that this is a fact, the Keokuk has within a short time acquired the necessary rights of way on this side of the river and also some $3,000,000 worth of real estate in North St. Louis, on which a fine warehouse and depot are being erected.

CHICAGO, ROCK ISLAND & PACIFIC.—Late reports state that this company has secured expensive terminal grounds at Ft. Worth, Tex., and that the completion of its southern extension to that point will be pushed. It will connect at Fort Worth with the Missouri, Kansas & Texas Ry. with which, it is stated, it will have close traffic relations.

KANSAS CITY & INDEPENDENCE AIR LINE.—Work is being rapidly pushed on this road between Kansas City and Independence, Mo. The road will be opened in about two weeks.

ATCHISON, TOPEKA & SANTA FE.—It is announced that the Montezuma branch of this road will be abandoned in the spring and the material will be used to put in the link in the Wichita & Western R. R. necessary to connect the road with the main line at Dodge City, Kan.

KANSAS CITY, WATKINS & GULF.—The grading is nearly completed between Lake Charles and Alexandria, La. The bridge gang is well up with the graders and tracklaying is making good progress.

Projects and Surveys.

KANSAS, ARKANSAS & NEW ORLEANS.—This company, which proposes to build a railway from Kansas City, Mo., to New Orleans, La., has filed a mortgage to the Farmers' Loan & Trust Co., of New York City, the money to be used in building a portion of its line.

TEXARKANA BELT.—A project is on foot to build a belt railway about 5 miles long at Texarkana, Tex. G. B. Abercrombie, Shreveport, La.

TRINITY, CAMERON & WESTERN.—The survey of this railway from Trinity to Granger, Tex., has been completed.

QUANAH & OKLAHOMA.—A bill has been introduced into Congress granting right of way for this railway through the Indian Territory.

Rocky Mt., and Pacific.—Existing Roads.

SANTA FE, PRESCOTT & PHOENIX.—This road has been graded from Phœnix, Ariz., north 20 miles, and 53 miles from Ash Fork south are under contract. The total length of the line between Phœnix and Ash Fork is 200 miles. N. R. Gibson, Phœnix, Ariz., Ch. Engr.

GREAT NORTHERN.—Foley Bros. & Guthrie, of St. Paul, Minn., have the contract for building a 6½-mile spur of the Montana Central Ry., to the Anaconda mines.—It is stated that the grading between Sand Point, Idaho, and Chatteroy, Wash., is practically completed. Tracklaying is reported in progress from Sand Point west, and according to a recent statement of one of the engineers it will be completed to Chatteroy by May 1.

BURLINGTON & MISSOURI RIVER.—Work on the extension from Gillette toward Buffalo, Wyo., is being rapidly pushed.

SOUTHERN PACIFIC.—Forty-one bids were received for building the first 17 miles of the line between Santa Marguerita and San Luis Obispo, Cal. The work includes the construction of seven tunnels, aggregating 7,000 ft. in length, and 16,000 cu. yds. of masonry. The work will cost about $1,500,000.

Projects and Surveys.

DEMING & UTAH VALLEY.—Chartered in New Mexico to build a railway from Deming to Gallup, N. Mex., a distance of 300 miles. Among the incorporators are: D. A. R. McLaren, of Deming, N. Mex., and J. L. Fielden, of Silver City, N. Mex.

PUGET SOUND & PACIFIC OCEAN.—This company has been incorporated in Washington to absorb the Mason County Central R. R. Its officers are: Pres., Edward F. Perry, Park City, Utah; V. P., Robert Caithness, Tacoma, Wash.; Treas., F. H. White; Sec., Eben Smith, Seattle, Wash.; Supt., E. H. Caine, Seattle, Wash. The same men have organized the Perry Lumber Co., which has purchased the property of the Shelton Mill Co., and which will carry on a large lumber business in connection with the roads.

ARLINGTON & MONTE CRISTO.—According to the surveys the work on this proposed railway to the Monte Cristo mines, in Washington, will be very heavy. According to the reports two surveys have been made, leaving Hartford, Wash. One reaches the mines via Sauk, and runs thence to Silverton, Chases and the South Fork of the Stillaguamish River. The other runs along the South Fork from Hartford to Chases. The work will necessitate several tunnels.

OGDEN & SAN FRANCISCO SHORT LINE.—This company has been organized to build a railway from Ogden, Utah, to the Pacific coast. The reports state that it will run directly across the Great Salt Lake, and will be built by "foreign capitalists."

ELECTRIC RAILWAYS.

FALL RIVER, MASS.—The street railway system is now in the hands of a new company, which will introduce electric traction this spring.

NEW YORK, N. Y.—An electric railway on the Southern Boulevard is proposed by a company represented by Mr. Edward Lauterbach and Mr. McNamara, General Manager of the Metallic Steel Railway Supply Co., of Albany, N. Y. Mr. R. Clarence Dorsett and Mr. Wm. R. Brown are on the property owner's committee.

BROOKLYN, N. Y.—The State Railroad Commissioners have approved the proposed change of motive power by the Brooklyn City & Newtown Ry. Co. from horses to the overhead single trolley electric wire system. The company is required to place a longitudinal guard wire over the track wire to prevent broken telephone or other wires from falling upon the latter.

LOS ANGELES, CAL.—The cable railway company will introduce the electric system on its horse car lines.

RACINE, WIS.—The Belle City Street Ry. Co. has been granted permission to build 7 miles of extensions, and proposes to adopt an electric system at an estimated cost of $200,000.

HORSE RAILWAYS.

WESTBROOK, ME.—The Portland Ry. Co. has been granted permission to lay tracks on the streets. The weight and style of rail are specified and the company is to lay granite paving between the rails.

NEWPORT NEWS, VA.—A street railway is to be built by Mr. Darling, of Hampton.

HIGHWAYS.

OHIO.—Pultney township, in Belmont Co., will vote on the expenditure of $66,000 for three turnpikes.

ILLINOIS.—A road improvement movement is on foot among the wheelmen and farmers. It is proposed to ask the Legislature to establish a board of road commissioners, which should have the power of making special assessments on a county, and using the money to repair the roads of that county, or, if necessary, to build new roads when it has only dirt roads.

CALIFORNIA.—A vote will be taken in San Diego Co. on Jan. 25 on the proposition to issue $630,000 bonds for a highway from Fosters Station to San Jacinto.

BRIDGES, TUNNELS AND CANALS.

BOSTON, MASS.—The proposed bridge over the Boston & Albany R. R. tracks is estimated to cost $120,000.

COLUMBUS, O.—All the plans are finished for the proposed viaduct on High St. The structure will cost about $500,000.

DELAWARE CO., PA.—A bridge to cost $10,000 will be built over Brandywine Creek at Chadds Ford.

ALBANY, N. Y.—A new toll bridge is to be erected across the Hudson River at this place to take the place of Bath ferry.

BOSTON, PA.—A company is to be organized to build a bridge over the Youghiogheny River at this place.

WATER-WORKS.

New England.

LANCASTER, N. H.—The Lancaster Water Co. desires bids for about 978 tons of pipe and also for some 12 miles of trenching and pipe-laying.

BRISTOL, VT.—It is reported that the Rock Springs Water Co. will build a 50x100 ft. reservoir and add some hydrants during the coming season.

WORCESTER, MASS.—Plans and specifications for raising the dam of the Holden storage reservoir 10 ft. have been prepared by Cy. Engr. C. A. Allen. Estimated cost, $100,000. Authority to raise money for the work must first be secured from the legislature.

EAST HARTFORD, CONN.—It is reported that the East Hartford Water Co. has decided upon a source of supply.

GREENWICH, CONN.—The Greenwich Water Co. thinks of building a new storage reservoir near the present one, and has bought land for that purpose.

SAUGATUCK, CONN.—There is talk of securing a supply from the East Norwalk extension of the Norwalk works. The Westport Water Co. was incorporated some months ago and proposed to supply Naugatuck.

TERRYVILLE, CONN.—The Terryville Water Co. has just been incorporated by W. P. Sweet and Richard Baldwin, Terryville, and others; capital stock, $14,000.

Middle.

ALBANY, N. Y.—According to the Albany "Journal" the Council Water Committee has reported against the proposed supply from the Normanskill. The "Journal" thinks the report will be adopted and that proposals for filtering water from the Hudson River will be asked.

MAYVILLE, N. Y.—The Water Commissioners desire bids until Feb. 1 for building works.

ASBURY PARK, N. J.—The Township Committee has granted the New Jersey Shore Water Co. permission to lay pipes through the roadways of the township of Neptune, excepting the avenues running to the sea through Asbury Park, Ocean Grove and Key East, and the macadam road between Shark River and Deal Lake.

MANASQUAM, N. J.—The "Democrat," of this place, states that before next summer works will be completed to supply a summer resort known as Rumson Neck. An artesian well has been driven, and a stand-pipe will be erected.

BRYN MAWR, PA.—Geo. B. Roberts, John H. Converse, Walter W. Wood and others are the parties who desire to secure the incorporation of the Union Water Co., noted last week. Lower Merion Township will be supplied.

COROAPOLIS, PA.—The Coroapolis Water Co., which has a capital stock of $35,000, has organized by electing C. E. Cornelius, Prest., T. E. Cornelius, Secy., and F. W. Patterson, Treas. It is proposed to sink a well near a channel of the Ohio River. Direct pumping may be used, and a reservoir added later.

WESTFIELD, PA.—It is reported that the Westfield Water Co. has elected new officers and will build works during the coming season.

PENNSYLVANIA.—On Feb. 9 Edmund P. Hammerly, W. G. Thomson and others will apply for charters for the Villa Nova Water Co., of Radnor Township, and the Suburban Water Co., of Haverford Township.

CUMBERLAND, MD.—Authority to issue bonds to the amount of $200,000 for a new supply and other improvements will be asked.

Southern.

FAYETTEVILLE, N. C.—It is reported that the Fayetteville Water Power Co. has been incorporated by J. M. Gardner [probably of Ashland, Ky.], T. D. McGlasson and J. D. McNeill; capital stock, $100,000.

ALEXANDRIA, LA.—The council has granted a franchise to J. P. Couillard, of Natchez, and Welch & Marye, of Alexandria (not of Philadelphia, as stated Jan. 16). The supply, as proposed, will be from Lake Caster, said to be eight miles distant. Address above, or Councilman E. J. Sullivan.

ARCADIA, LA.—A supply from springs about two miles distant is projected.

NEW ORLEANS, LA.—The company is taking steps to issue $250,000 of bonds to be used in providing a filtering plant and possibly for other improvements. Supt., L. H. Gardner.

EAST CHATTANOOGA, TENN.—It is reported that the land company talks of building works.

NASHVILLE, TENN.—Appropriations of $20,000 for meters, $3,500 for remodeling pump foundations and well and $7,500 for a new boiler house are proposed.

PARKLAND, KY.—J. R. Crawford is said to be at the head of the projected company.

North Central.

BOWLING GREEN, O.—L. Newcomer, Cleveland, has applied for a 30-year franchise and 20-year hydrant contract, the latter at the rate of $100 per year for 60 hydrants. The application is under construction.

LEETONIA, O.—Plans for an extension to the street mains are being made by J. B. Strawn, Salem. Estimated cost $5,000.

NAPOLEON, O.—Preliminary plans and estimates for works are being made by J. B. Strawn, Salem, O.

NILES, O.—Works have recently been completed. Engr., J. B. Strawn, Salem; Contr., C. H. Cornell, Youngstown.

NORTH BALTIMORE, O.—The contract for two compound pumping engines and for boilers and appurtenances has been awarded to the Laidlaw & Dunn Co., Cincinnati.

NORWALK, O.—C. A. Judson, Sandusky, has reported to the city on possible water supplies from Rogers and Norwalk creeks. A supply from either source includes a dam or dams and a pumping station. Estimated cost, about $85,000, excluding land.

BREMEN, IND.—The people have voted for works. Address C. Sinninger.

LOGANSPORT, IND.—About three miles of mains will be laid this year. Address Trustees.

BENTON HARBOR, MICH.—Contracts for works have been or are about to be closed. A. V. Powell, Chicago, Consult. Engr.

KAUKAUNA, WIS.—A press dispatch from this place conveys the idea that works will not be built very soon.

MILWAUKEE, WIS.—The Council water-works committee has reported in favor of buying a pump for the Tenth Ward high service station at a cost of $8,000. The report was adopted.

NEENAH, WIS.—City works are talked of.

Northwestern.

FORT MADISON, IA.—The difficulties between the city and company have been settled, and the works will be improved.

OTTUMWA, IA.—The water-works power-house was recently burned.

SIOUX CITY, IA.—Godfrey & Meals, Fremont, Neb., have offered to furnish a supplementary daily supply of 2,500,000 gallons for $25,000, using the Isabella st. plant and machinery. At this station wells were recently sunk which did not yield the amount contracted for.

GREAT FALLS, MONT.—E. W. King, Supt. Great Falls Water Co., informs us that the company expects to lay 10 or 12 miles of pipe during the coming season.

Southwestern.

BUTLER, MO.—There is talk of extending the mains to supply the railway station and citizens of West Butler.

ROCKPORT, MO.—L. C. Christian, City Clerk, informs us that the people have voted to issue $6,000 of bonds for water-works and the same amount for electric lights.

HELENA, ARK.—The Cook Well Co. has struck water for the Helena Water Co. at a depth of 494 ft. Another well will be sunk. Works will probably be built at once. Prest., M. P. Hillyer, St. Louis.

DUBLIN, TEX.—The Southern Improvement Co., Dallas, has received the contract from the Dublin Water-Works Co.

GUTHRIE, OK. T.—Plans and estimates for works have been completed by the Neir Engineering Co., St. Louis, Mo.

DEL NORTE, COLO.—Bonds for works have been sold and it is expected that construction will be started in the spring.

Pacific.

SEATTLE, WASH.—An ordinance has passed the House of Delegates authorizing a 36-in. intake pipe, from 500 to 850 ft. long, at the Lake Washington station; an inlet well; and a 20-in. force main from the above station, 7,400 ft. long. This ordinance passed the Board of Aldermen some months ago, and was noted in these columns at the time. A resolution was adopted to the effect that iron pipe be bought on the Pacific Coast, and that steel pipe for the intake, if used, be made at Seattle, provided it proves possible.

SNOHOMISH, WASH.—Cummings & Cook, Aberdeen, have just received the contract for works here at $43,890. There will be a pumping plant and reservoir. Dunham, Corrigan & Hayden Co., San Francisco, will supply part of the material.

SPOKANE FALLS, WASH.—W. S. Norman, Mgr. Edison Electric Illuminating Co., has made a proposition to furnish electric power for the pumping plant, power to be delivered at any point within a radius of three miles of the city. The price named for four periods of five years is as follows: first, $6,000; second, $10,000; third, $12,000; fourth, $15,000; or electricity will be delivered at the rate of $5 per million gallons of water pumped.

PORTLAND, ORE.—A supply is projected for East Portland Heights, outside the city limits. Either an independent pumping station or a connection with the works of the East Portland Water Co. is proposed.

LEMOORE, CAL.—Edward Erlaugh has leased a pumping plant formerly used by the railway company and will supply the town with water from an existing artesian well. An electric lighting plant may be run in connection with the works.

SAN JOSE, CAL.—E. B. Saunders has applied for permission to lay pipes to supply that partof the city known as the Cottage Grove Tract. An artesian well supply and wind mill and steam pumping plants have already been secured.

IRRIGATION.

NORTH YAKIMA, WASH.—R. Strabach, Secy., informs us that the Cowychie & Wide Hollow Irrigation District has voted to issue $500,000 of bonds. The district includes 50,000 acrees of sage brush meass land. Engr., Guy Sterling.

HOOD RIVER, ORE.—W. J. Roberts, The Dalles, is running a line for a canal for the Central Ditch Co. from the Hood River to land back of this town. If built the canal will water some 7,000 acres.

COLTON, CAL.—Bids will be received until Feb. 2 by the Citrus Belt Irrigation District for $800,000 of district bonds in denominations of $500 each. Prest., M. E. Foulke.

DELANO, CAL.—The Poso Irrigation District has let contracts for the construction of its works to J. M. Thompson, San Francisco, and J. H. Smith, Seattle. The supply will be from Poso Creek. The works will include, it is said, two large dams and reservoirs, and 65 miles of canal, with several miles of flumes. The contract price was $440,000, to be paid in bonds of the district at par. Work is to be completed within a year. Secy., J. E. Anderson, Spottiswood.

GRAPELAND, CAL.—The Grapeland Irrigation District, J. L. Adams, Director, will receive bids until Feb. 2 for constructing ditches on section and half section lines running north and south through the district. Engr., F. C. Finkle, San Bernardino.

LLANO, CAL.—The Big Rock Creek Irrigation District proposes to enlarge and extend its ditches. John Cull has offered to do the work and take his pay in bonds of the district. Secy., L. C. Tilghman.

LINDA VISTA, CAL.—Bids will be received by the Linda Vista Irrigation District until Feb. 2 for supplying to the district 2,000 miner's inches (under 4-in pressure) of water, 500 ins. to be delivered within 1¼ years, 500 more within 2½ years and 1,000 more within 3½ years. An option of an additional 500 ins. whenever the district may wish it, must te given. Bidders must give full particulars regarding the proposed works. Bids will also be received for water rights and dam sites within San Diego Co., including surveys, of sufficient capacity to supply 2,500 ins. of water. Prest., Jas. P. Jones; Secy., Geo. K. Phillips.

LODI, CAL.—The Stockton & Lodi Irrigation & Canal Co. has been incorporated at Chicago, Ill., with a capital stock of $2,000,000. It is stated that canals will be built of such a character as to furnish water for irrigation and at the same time means of transportation. Locks will be used. S. R. Walker, probably of Chicago, is one of the incorporators, and Dr. Gordon, of Lodi, Cal., is thought to be interested in the project, the latter having been looking up the Mokelumne irrigation scheme. It is stated that construction will be started at once in order to complete works by 1893.

SAN DIEGO, CAL.—The "San Diegan" states that the Jamacha Irrigation District will vote Jan. 30 on the issuance of $700,000 of bonds to pay for water rights and put in a distribution system. The district has acquired the water rights of the San Miguel Water Co.

ARIZONA.—The Arizona & Sonora Land & Irrigation Co. recently filed articles of incorporation at Denver, fixing its capital stock at $7,500,000. Prest., Chas. H. Dow; V.-P., Jas. H. Brown; Secy., F. A. Miller. A dispatch to the St. Louis "Globe-Democrat" states, in effect, that the company has obtained a concession from the Mexican Government of 1,500,000 acres of land on the Arizona side of the Colorado River below Yuma, joining the Arizona line for 60 miles eastward from the Colorado. Upon this concession, and possibly upon land in Arizona from the Gila southward, the company proposes to diqert the waters of the Colorado River. The company contemplates the construction of a canal 124 ft. wide, irrigating 400,000 acres of land at at expenditure of $3,500,000.

NEW COMPANIES.—Plum Creek & Hastings Canal Irrigation Co., Dawson and Phelps Cos., Neb.: T. L. Warrington and W. A. Stewart, Lexington, and C. J. Dilworth, Hastings; $15,000. La Junta & Lamar Canal Co., Colo.: A. Coulson, E. A. Fay and Geo. S. Redfield; $100,000; to complete the work begun by the Arkansas River Canal Co. Colorado Farm, Land & Irrigation Co., Las Animas and Bent Cos., Colo.: T. B. Sweet, Jacob Mulvane and others; $1,000,000. Penasco Reservoir & Irrigation Co., Eddy, N. M.; J. F. Hinkle, A. B. Fall and others; $1,000,000.

SEWERS.

BOSTON, MASS.—The board has appropriated $250,000 for the construction of improved sewerage. The Mayor's annual estimate includes $350,000 for sewers.

BROCKTON, MASS.—The Mayor has been authorized to petition the Legislature for permission to negotiate a loan of $300,000 for a system of sewerage for the city.

NEWTON, MASS.—Preliminary steps will soon be taken for the construction of over 8 miles of sewers in West Newton, which will be completed, it is expected, in time for use in the fall. Probably about a mile of sewer will be laid in Auburndale this year.

PROVIDENCE, R. I.—Bids are asked by Robert E. Smith, Comr. Pub. Wks., until Jan. 29 for building 5,665 ft. of main sewer.

FLATBUSH, N. Y.—The engineer has been directed to prepare plans and specifications for additional sewers to be constructed this coming spring.

NEW ROCHELLE, N. Y.—A bill is before the Legislature intended to enable the village to borrow $75,000 and complete its sewers. At present work is suspended. No outlet has been built and one important section has not been begun.

NIAGARA FALLS, N. Y.—Plans for a complete sewerage system have been prepared by Johnson & Debaud, engineers. The estimated expense is from $200,000 to $250,000. A special meeting of the taxpayers has been called for Jan. 25 to vote upon the subject.

ROCHESTER, N. Y.—The contract for the Front St. outlet sewer has been awarded to Braver & Albraugh and that for the Rowe St. pipe sewer to Bauer & Bruff, these being the lowest bidders. Ordinances have been passed for two additional pipe sewers to cost $9,500.

ORANGE, N. J.—The sewerage committee has presented forms of advertising for proposals, and recommend that resident labor be used on the work. Bids for the outlet sewer will be received until Feb. 8, and for the Valley section until Feb. 17. The city counsel was instructed to prepare the necessary enabling statute for the construction of a sewer through the neighboring townships, to be passed by the Legislature.

KITTANING, PA.—Engrs. Wilson & Smith, Saltsburg, Pa., inform us that at the February election a vote will be taken on the introduction of sewers during the present year.

MONONGAHELA CITY, PA.—Surveys and maps for a system have been nearly completed by Engrs. Wilson & Smith, Saltsburg, Pa. The separate system will be used with the exception that storm water will be admitted to sewers in the lower parts of the town. At least a portion of the system will probably be built during the coming season.

NANTICOKE, PA.—The council has decided to submit the question of a sewerage system to a vote of the people.

UNIONTOWN, PA.—We are informed by Wilson & Smith, Engrs., Saltsburg, Pa., that sewerage and paving are talked of.

RICHMOND, VA.—A sewer to cost about $4,000 has been ordered; $50,000 of sewer bonds are under consideration.

COLUMBUS, GA.—At an election Jan. 16, the question of issuing $135,000 of bonds for sewerage construction was voted upon.

TAMPA, FLA.—Mayor Post has submitted to the City Council a letter from Col. Geo. E. Waring, Jr., and urges that prompt action be taken with regard to the construction of a system of sewerage.

CHATTANOOGA, TENN.—Bids will be received for a 10-in. pipe sewer 800 ft. long.

NASHVILLE, TENN.—At the last meeting of the City Council bills were passed for 8 brick sewers the estimates aggregating $15,500.

COLUMBUS, O.—Bids for the construction of sewers in six alleys have been referred. H. C. Babbitt will construct all the sewers in the sub-sewer district P of District 2.

FINDLAY, O.—The Board of Improvements has a sewerage system mapped out for the city south of the river.

TOLEDO, O.—Bids will be received by the City Clerk until Feb. 1 for the construction of 6 sewers—two 12-in. pipe, two 20 in. brick and two 24 in. brick.

WOOSTER O.—Eight bids were received for constructing the West Liberty St. sewer. The contract was awarded to E. A. Williams, the lowest bidder.

ANN ARBOR, MICH.—The Sewerage Committee has agreed upon a 24 in. system of mains, and to cross private property. A special election is to be called for Feb. 15.

FREEPORT, ILL.—Cy. Engr. Lagron has completed plans for the new sewer system.

MADISON, WIS.—The council has directed that a new sewer be built in the Baldwin St. district.

COUNCIL BLUFFS, NEB.—Engr. Tillotson estimates the cost of the proposed sewer on Valley St. at $17,000.

NORTH PLATTE, NEB.—A local company is being organized to put in a system.

DENVER, COLO.—About $40,000 of sewers are being prepared for contract. It is claimed that only half of the city is at present provided with a sewer system.

HIGHLANDS, COLO.—Sewer bonds to the amount of $14,000 have been issued.

OAKLAND, CAL.—The next sewer construction will be in the Fourth Ave. district. The sewer will be about a mile in length and drain the whole country now emptying into the valley.

BALLARD, WASH.—The Mayor says the question of bonding the town for a system of sewers will soon be considered.

COLFAX, WASH.—A system of sewers will be built, work to begin in March.

WINNIPEG, MAN.—The City Engineer has submitted a list of sewers to be built. Work on most of them will be held back for a couple of months, but bids will be asked for the construction of seven at once.

STREETS.

BOSTON, MASS.—The Mayor's estimate for the ensuing year includes $850,000 for street paving.

BROOKLYN, N. Y.—Bids have been opened for grading and paving on three streets, two with Belgian blocks and one with cobblestones. There were 11 bids, aggregating from $24,604 to $32,118. Owen O'Keefe was the lowest bidder on each contract.

MOUNT VERNON, N. Y.—The contract for paving South Fourth Ave., which is the principal thoroughfare in Mount Vernon, has been awarded to Harry P. McTague.

FLEETWOOD, PA.—A new charter has been granted, and street improvements are expected as soon as the weather will permit.

WASHINGTON, D. C.—The Commissioners have ordered the construction of plank sidewalks on four streets.

SAVANNAH, GA.—The Warren-Scharf Asphalt Co. offers to finish the asphalting of Bull St., and wait for payment till September. The additional paving will cost about $25,000, exclusive of curbing, should the offer be accepted.

KISSIMMEE, FLA.—The council has directed that wood, brick or stone sidewalks be constructed on the three principal business streets. Wood will be used almost exclusively.

NASHVILLE, TENN.—Bills for $11,850 of granite and $7,568 of brick paving have been passed.

COLUMBUS, O.—The city engineer is preparing estimates for the improvement of several streets.

FINDLAY, O.—The contract to pave North Main St. with brick has been awarded to Samuel Myers, but as the bid of Dorney & Harris is reported $4,500 lower an injunction has been secured to prevent the completion of the contract. A bill authorizing the city to issue $150,000 worth of improvement bonds has been prepared.

TOLEDO, O.—Street improvement bonds to the amount of $43,795 will be sold Feb. 8.

WORCESTER, O.—There were eight bids received for paving South Market St., that of Landers & Betson being the lowest.

INDIANAPOLIS, IND.—The Board of Public Works ordered and completed $320,665 worth of streets last year, in addition to the work ordered by the council. The streets to be improved this year are now being selected.

DETROIT, MICH.—About $500,000 worth of paving will be laid this year.

ST. LOUIS, MO.—Bids for street work aggregating $17,247 have been awarded. The largest single contract was one for Telford pavement, Fletcher & Higgins, $2,950.

SAN FRANCISCO, CAL.—Bids for over $40,000 worth of street work have been awarded. The largest single contract was to Warren & Malley at $25,000.

TACOMA, WASH.—The city council has voted to improve 12 streets.

TORONTO, ONT.—Last year 74 contracts were let in the roadway department, over 9 miles of cedar blocks and nearly 2 miles of asphalt being laid. A contract has been awarded to Burns & McCormack at $7,999 for a cedar pavement on one street.

ELECTRICAL.

MARBLEHEAD, MASS.—The committee chosen to consider the advisability of establishing a town electric lighting plant has reported favorably. It finds that during the past 10 years the cost of lighting the streets has been increased, until for 1891 the cost exceeded $4,000. The committee says that a plant capable of lighting the town can be put in at a total cost of $40,000.

ORANGE, N. J.—The street lighting committee has reported a contract with the Essex County Electric Co. similar to the previous contract, with the exception that a clause was added that Orange should have the benefit of any reduction in rates that the company may make for any other municipality.

COLUMBIA, S. C.—The Columbia Gas & Electric Light Co. and the City Railway Co. have consolidated. The new company has sold $100,000 of bonds, and arrangements will soon be made for the construction and equipment of an electric light plant.

HARTFORD, KY.—An electric plant will soon be constructed by a local company. Write J. W. Ford & Co. for information.

CINCINNATI, O.—A special committee of 10 has been appointed to consider the subject of lighting the city. The Chief Engineer has been directed to divide the city into five districts, and specifications are being prepared for a separate contract for each district.

NEWARK, O.—Plans and specifications for an electric light plant have been submitted by the special committee, and are now being considered by the City Council.

PIQUA, O.—The city is much disturbed over the lighting contract, and it is said the city will construct a plant.

INDIANAPOLIS, IND.—Bids will be received by the Board of Public Works until Feb. 15 for 750 arc lights of 2,000-c. p. to be suspended on mast arms, for periods of both five and ten years.

APPLETON, WIS.—The contract with the Appleton Gas Light Co. expires Jan. 22, and it is intended to contract with the electric light company of that place to furnish 100 arc lights for $5,000 a year.

EDGERTON, WIS.—The Common Council has annulled the contract with the Electric Light Co.

CHATTANOOGA, TENN.—The Chattanooga Electric Light & Power Co. has voted to improve its plant.

SAN DIEGO, CAL.—The city desires bids for street lighting.

NEW COMPANIES.—Fair Electric & Manufacturing Co., Hoboken, N. J.; J. Fehr and L. A. Fehr, of Hoboken, and G. Cronemeyer, of New York City; $100,000.—Duquesne Heat, Light & Power Co., Duquesne, Pa.; W. B. Rath, M. G. Conlin and H. F. Black; $20,000.—Paris Electric Light & Railway Co., Paris, Tex.; S. J. Wright, J. J. Walsh and John Martin; $300,000.—Montgomery Electric Light & Power Co., Montgomery, W. Va.; T. B. Davis, J. W. Montgomery and J. C. Montgomery; $50,000.—Troy Electric Light & Power Co., Troy, Pa.; B. B. Mitchell, Daniel Fletcher and Jno. Parsons, $10,000.—The Logan Electric Light Co., Logan, O.; John Hansen, John F. White and J. A. Stiers; $20,000.

CONTRACT PRICES.

ROCK AND BRUSH.—The bids for improving the Mississippi River between Des Moines Rapids and the mouth of the Illinois River have been opened by Maj. E. H. Ruffner, Corps of Engineers, Quincy, Ill. The following were recommended for acceptance: Henry L. Hart, Louisiana, Mo., 10,000 cu. yds. rock delivered at Hamburg, Ill., 66 cts.; 15,000 cu. yds. brush delivered at either Louisiana or Hamburg, 29½ cts.; Reid, Brosi & Ebert, Quincy, Ill., 5,000 to 15,000 cu yds. rock delivered at La Grange, Mo., 69¾ cts.; Hannibal Lime Co., Hannibal, Mo., 6,000 cu. yds. rock delivered at Hannibal, Mo., 53 cts.; 4,000 cu. yds. rock delivered at Hannibal, Mo., 54¾ cts.; Frederick W. Wenke, Quincy, Ill., 2,500 cu. yds. rock delivered at Quincy, Ill., 62 cts.

PIPE.—Worcester, Mass.—The Committee on Water has awarded the following contracts: Warren Foundry & Machine Co., New York, 1,545 tons of iron pipe, $23.90 per ton; Donaldson Iron Co., Emaus Pa., 4-in. pipe at $25.13, all other kinds at $24.23. The bids were for lots of 175 tons of 16-in. pipe, 400 tons 12-in., 400 tons 8-in., 450 tons 6-in., 40 tons 4-in., 30 tons 12-in. heavy, 30 tons 8-in. heavy, 20 tons 6-in. heavy. Washburn & Garfield, Worcester, was awarded contracts for 3,500 ft. of wrought iron pipe at $1,488, and brass work at $912.63. The Holyoke Machine Co. was awarded contract for castings at 2¼ cts. per lb. The contract for pig lead was awarded to the Chadwick Lead Works, Boston, at $4.32½ per cwt., and that for lead pipe to the Boston Lead Co. at $5.20 per cwt.

Baltimore, Md.—Contracts for supplies for the year have been awarded by the Water Department as follows: Cast iron pipe, Radford Pipe Foundry Co., Radford, Va., $52,515; cast-iron castings, pipe-fitting and special castings, James R. Lacy & Co., at 2½ and 1 85-100 cts. per lb. respectively; lumber, Heise & Bruns, $10 per M. B. M.; brass stops, H. McShane Manufacturing Co., 91 cts.; brass ferules, J. Regester & Sons, 15 cts.; special castings, William Gisriel, 12½ cts.; jute packing, Johnson Bros., 5⅝ cts. per M.

Richmond, Va.—Bids have been opened for furnishing the city with sewer castings during the present year as follows: Talbott & Sons, 2 cts. per lb.; Joseph Hall & Co., 2¼ cts. per lb.; Burton & McGhee, 2¼ cts. per lb.; J. E. Hendl & Co., 2 1-16 cts. per lb. The contract was awarded to the lowest bidder.

SEWERS.—Brooklyn, N. Y.—Bids have been opened for the construction of three sewers. That of Richard Whalen was the lowest for each street, and is as follows: 12-in. cement pipe, 99 cts. per lin. ft.; 15-in., $1.35; manholes, each, $37; street basins, each, $95.

BRICK.—Washington, D. C.—The Commissioners have received 10 bids for furnishing the District with vitrified brick. The lowest bids were as follows: For repressed brick, McMahon, Porter & Co., $17.93 per M.; for ordinary brick, American Fire Clay Co., $17.72 per M.

Seattle, Wash.—The Board of Public Works opened the following bids for material for the lining of the Lake Union sewer tunnel: Puget Sound Brick & Tile Co., brick, $8.85 to $15 per M., according to quality; J. H. Thompson, English Portland cement, $3, Belgium, $2.15, on wharf at Seattle; Matt Brannigan, brick, $9.50 per M., crushed rock, $1.90 per cu. yd., Portland cement, $3.10 per bbl.; Seattle Brick & Tile Co., best sewer brick, $8.80, best vitrified, $12 per M., crushed rock, $4; R. J. Haslan, crushed rock, $4.85; C. A. Carlson, crushed rock, $2.05.

MISCELLANEOUS.

CRIBS.—Detroit, Mich.—Bids will be received until Feb. 4 for furnishing the material and labor for eight stone cribs for the St. Mary's River Lights. For information write to Wm. Ludlow, Engr. Eleventh Light House District, Detroit.

FIRE BOAT.—Brooklyn, N. Y.—Bids will be received at the Fire Department, 154 Lawrence St., until Jan. 26, at noon, for building and constructing one fire boat, hull, boilers and machinery, according to plans and specifications on file at the headquarters of the Fire Department.

GARBAGE.—Brooklyn, N. Y.—The contract for the removal of garbage for 5 years has been awarded to Bartley French, the lowest bidder, at $630,000.

DRAINAGE.—Warsaw, Ill.—A project is on foot to drain Lima Lake, in Adams Co., Ill., and thus reclaim 6,000 acres of the best soil in the county. If the County Court acts favorably on the petition, Feb. 4, the work will be pushed rapidly forward. It is proposed to cut four ditches through the lake, making 10 miles of ditches. One of these will be 40 ft. wide and the others 20 ft. wide and 6 ft. deep, and to complete the work will require the excavation by dredges of 365,000 cu. yds. of earth.

BONDS.—Ogden, Utah; $50,000 improvement bonds. Denver, Colo.; $320,000 improvement bonds. Montreal, P. Q.; $344,000 harbor bonds.

MANUFACTURING AND TECHNICAL.

LOCOMOTIVES.—The Baldwin Locomotive Works, of Philadelphia, Pa., are building a four-cylinder compound engine for the Abt rack railway up Pike's Peak; it will weigh about 60,000 lbs. The Cooke Locomotive & Machine Works, of Paterson, N. J., are building 10 ten-wheel engines, with cylinders 18 × 24 ins., for the International & Great Northern.

CARS.—The Central Vermont will turn out about 30 freight cars per day from its shops at St. Albans, new machinery having been put in. The Pullman Palace Car Co., of Chicago, Ill., has a contract for 120 passenger cars for the Chicago & Northwestern. The Ensign Car Works, of Huntington, W. Va., have an order for freight cars for South America. The Florida Car & Mfg. Co., of Green Cove Springs, Fla., has been incorporated by M. C. Blain and A. A. Silber; capital stock, $150,000. The Southern Street Car Co., of Pensacola, Fla., has been incorporated by J. H. Carter, J. W. Dorr and T. H. Curry; capital stock, $500,000; R. E. Sharrard is Superintendent.

MACHINERY.—T. R. Crane, of Martinsburg, W. Va., is in the market for iron and woodworking tools for his new factory for the manufacture of agricultural implements.

THE RADFORD PIPE & FOUNDRY CO., of Radford, Va., and Cincinnati, O., has opened an office at 128 Broadway, New York, in charge of Mr. W. T. Partridge.

THE BERLIN IRON BRIDGE CO., of East Berlin, Conn., is completing a machine shop for the Bridgeport Machine Tool Co., at Bridgeport, Conn. It is 90 ft. long, and is of brick and iron, divided into two parts, each 40 ft. wide. One portion is 2 stories high, the roof and floor being designed for light work; while the other is of the same height, but the second floor is omitted, so that it may be used as an erecting shop. The erecting shop is controlled by a traveling crane.

WILSON AND SMITH, engineers and surveyors, Saltsburg, Pa., report the following work done during the past year: Supervision of 6 miles of sewers and about 5 miles of paving at Washington, Pa.; plans for trunk sewer at Corry, Pa., now being constructed under their charge; report of sewers for Kittaning, Pa.; superintendence of 6 mines, plans for two collieries and topographical surveys in the Eldersridge coal field. During the year the senior member of the firm, Mr. R. H. Wilson, has been elected a member of the American Institute of Mining Engineers and the junior member, Mr. Albert Smith, an associate member of the American Society of Civil Engineers. Work now in hand by the firm is noticed under "Sewers."

ELECTRIC INSTALLATIONS.—H. Ward Leonard & Co., electrical engineers, report that they are at present putting in plants in the following more prominent buildings: "Mail and Express," C. Bradley, Geraldine, Franklin Trust, Fifth Avenue Theatre and Graham Hotel, in New York City, and the Columbia Theatre, in Brooklyn. This firm is also acting as consulting engineers for the following leading concerns: Otis Elevator Co. and Ingersoll-Sergeant Rock Drill Co., New York City; Wm. Sellers & Co., Philadelphia; Eastern Electric Co., St. John's, N. B. "Providence Journal" Co.; and the Rock Hill Electric Light Co., Rock Hill, S. C.

NEW COMPANIES.—De Witt Brick & Tile Co., of Little Rock, Ark.; $10,000; President, J. A. Gibson. Johnston Car Coupling Co., of Camden, N. J.; $1,600,000; E. H. Johnson and D. S. Grofly, of Philadelphia; F. P. Moggridge, of Atlantic City, N. J. O. B. W. Felter Co., of Peoria, Ill.; $30,000; G. D. Wolcott, J. L. Wells and F. O. Lyon. Railway Automatic Signal Co., of Perry, Ia.; $100,000. Kansas City Sand & Dredging Co., of Kansas City, Kan.; $20,000; D. B. Vansyckle, Kansas City, Kan., and Michael Tandy, Kansas City, Mo.

CURRENT PRICE LIST.

RAILS.—New York: $30 to $30.50; old rails, $21 to $21.25 for iron and $14 to $15 for steel; girder rails, $40. Pittsburg: $30; old rails, $22.50 to $23 for iron and $16.75 to $18 for steel. Chicago: $31; old rails, $22 to $22.35 for iron and $14.50 for steel.

TRACK MATERIALS.—New York: steel angle bars, 1.7 to 1.75 cts.; spikes, 2.1 to 2.2 cts.; track bolts, 2.65 to 2.9 cts., with square and hexagon nuts. Pittsburg: splice bars, 1.7 to 1.8 cts. for iron or steel; iron or steel spikes, 2.15 cts.; iron track bolts, 2.65 cts. with square and 2.75 cts. with hexagon nuts. Chicago: splice bars, 1.8 cts. for iron and steel; spikes, 2.2 to 2.25 cts.; track bolts, 2.7 cts. with hexagon nuts.

PIPE.—Cast iron, $20 to $30 per ton. Wrought iron, discounts as follows, at Pittsburg: 57½ and 47½% on black and galvanized butt-welded; 67½ and 55% on black and galvanized lap-welded. Casing, 55%.

FOUNDRY PIG IRON.—New York: $14 to $18. Pittsburg: $14 to $16. Chicago: $14.25 to $16.

LEAD.—New York: 4.15 to 4.2 cts. Chicago: 4.05 cts. St. Louis: 3.95 cts.

STRUCTURAL MATERIAL.—New York: beams, 3.1 cts.; channels, 3.1 cts.; angles, 1.9 to 2.1 cts.; tees, 2.4 to 2.75 cts.; sheared iron plates, 1.85 to 2.25 cts.; steel plates, 1.9 to 2.1 cts. for tank, 2.15 to 2.3 cts. for shell, 2.4 to 2.65 cts. for flange, 3 to 3.25 cts. for firebox. Pittsburg: beams, 3.1 cts.; channels, 3.1 cts.; angles 1.9 to 2.1 cts.; tees, 2.25 to 2.4 cts.; universal iron mill plates, 1.85 to 2 cts.; sheared steel bridge plates, 1.9 to 2 cts.; refined bars, 1.75 to 1.8 cts.; steel plates, 1.85 to 2.5 cts. for tank, 2 to 2.1 cts. for shell, 2.25 to 2.5 cts. for flange, 3.5 to 4.25 cts. for firebox. Chicago: beams, 3.2 cts.; channels, 3.2 cts.; angles, 2.05 to 2.15 cts.; tees, 3.4 cts.; universal plates, 2.12½ cts.; sheared steel plates, 2.2 to 2.25 cts.; steel plates, 2.4 to 2.6 cts. for tank, 2.75 to 3.5 cts. for shell, 3 to 3.25 cts. for flange.

IRON WORK.

CHICAGO, ILL.

Proposals are wanted until March 1, for the construction of an elevated structure, and the equipment and operation thereon of a method of transporting visitors about the Exposition grounds. The length of the structure will be about 5¼ miles of single track, with about 24 passenger stations; also the necessary terminal storage yards and sheds for the equipment. Address D. H. BURNHAM, Chief of Construction, World's Columbian Exposition, 1143 "The Rookery," as above.

Commonwealth of Massachusetts.

METROPOLITAN SEWERAGE COMMISSIONERS—NOTICE TO CONTRACTORS.

Sealed bids for building sections 13 and 14 of the Metropolitan Sewerage System in Chelsea, in accordance with the form of contract and specifications to be furnished by the Board of Metropolitan Sewerage Commissioners, will be received by said board at its office, 93 Lincoln St., Boston, Mass., until 12 o'clock M. of Saturday, Feb. 27, 1892.

No bid will be received unless accompanied by a certified check for the sum of $1,000.

All bids must be made upon the blank forms furnished by the board.

Some other particulars are approximately as follows:

Section.	Length, feet.	Average depth, feet.	External diameter, feet.	Cubic yards brick and other masonry.
13.	3,810	32.5	12	5,870
14.	2,590 trench.	30.2	12	4,300
	850 tunnel.	....	11	1,070

Plans can be seen and specifications and forms of contract can be obtained at the above office.

Brick must equal samples shown in the office of the Engineer.

Each bidder is required to make a statement indicating what sewer and tunnel work he has done, and to give references that will enable the board to judge of his business standing.

The board reserves the right to reject any and all bids.

Sections 13 and 14 are alternatives of each other. If a contract is made for one the bits for the other will be rejected.

HOSEA KINGMAN, TILLY HAYNES, ROBERT T. DAVIS, } Board of Metropolitan Sewerage Commissioners of Massachusetts.

HOWARD A. CARSON, Chief Engineer. 4 5t

UNITED STATES ENGINEER OFFICE. 34 West Congress street, Detroit, Mich., Jan. 19, 1892. Sealed proposals, in triplicate, will be received at this office until 2 o'clock p. m., March 4, 1892, and then opened: For furnishing twelve Valve Frames and fourteen Valves for the 8'0-foot Lock at St. Mary's Falls Canal, Michigan. Preference will be given to materials of domestic production or manufacture, conditions of quality and price (import duties included) being equal. Attention is invited to Acts of Congress, approved February 26, 1885, and February 23, 1887, vol. 23, page 332, and vol. 24, page 414, Statutes at Large. The Government reserves the right to reject any or all proposals; also, to waive any informalities. For further information apply at this office. O. M. POE, Colonel Corps of Engineers, Bvt Brig. General U. S. A. 4-4t

Drainage Pump.

COMPTROLLER'S OFFICE, CITY OF NEW ORLEANS, NEW ORLEANS, Nov. 20, 1891.

Sealed proposals will be received at this office until the hour of 12 M., Thursday, Feb. 18, 1892, for the construction of a new drainage pump, in accordance with plans and specifications on file in the office of the City Engineer. Copies of plans and specifications will be forwarded by mail on request. A deposit of $200 will be required to accompany each bid. The city reserves the right to reject any and all bids. All in conformity with Ordinance No. 5,753, C. S., adopted Nov. 10, 1891.

OTTO THOMAN, Comptroller. 48-13t

Proposals for Water-Works.

OLNEY, Ill., Jan. 8, 1892.

Sealed proposals will be received by the Mayor and Common Council of the city of Olney, Ill., until two o'clock of the ninth day of February, A. D. 1892, for the construction of a system of water-works, as per plans and specifications now on file in the office of the City Clerk. Proposals will be received for the work as a whole or for any part thereof but must be made strictly according to said plans and specifications, or they will not be considered. Each and every proposal must be accompanied with a certified check for the sum of $250, made payable to the City Treasurer of Olney, as a guarantee of good faith, said check to be returned to the bidder making it when his proposal has been rejected, or when accepted and satisfactory bond deposited with the Mayor and Council. Each and every proposal must be sealed and marked "Proposal for Water-Works," and must be filed with the City Clerk at his office in Olney, Ill., on or before the time stated above. The right is reserved to make any additions to or deductions from the materials to be furnished and work done, under the accepted proposal at proportionate prices, to the amount of 15 per cent. of the same at any time before the materials have been ordered, and the right is still further reserved to reject any and all proposals. JAMES E. WHARF, Mayor.

ED. C. WILSON, City Clerk. 3-3t.